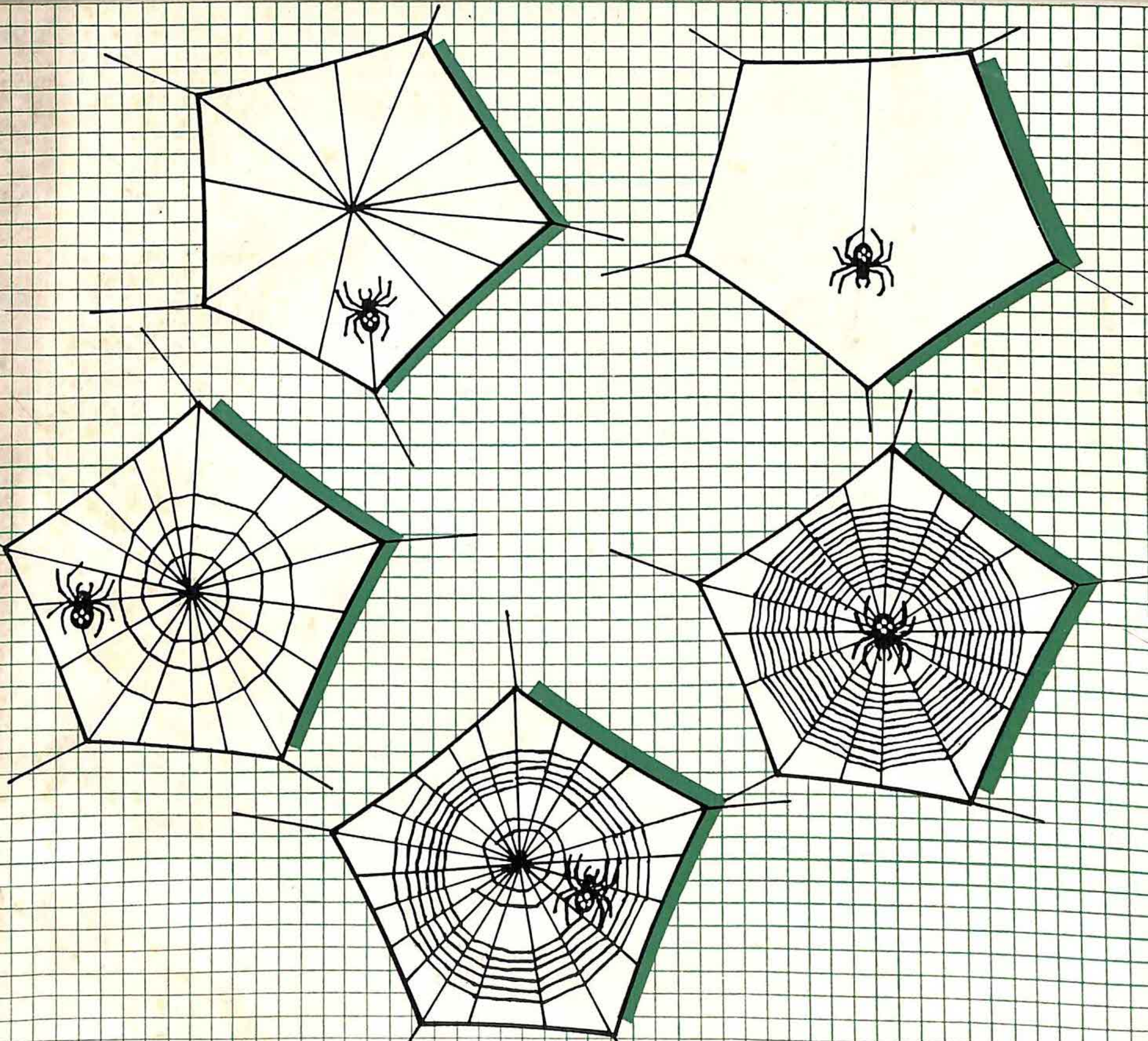
Understanding Science

BIOLOGY

Class VIII



S. Menon • K. Mediratta • P. Theodore

Understanding Science
BIOLOGY

3

Shyamla Menon
Dept. of Biology
Lady Irwin School
Canning Lane
New Delhi

Kanchan L. Mediratta
Principal & Head of the
Dept. of Biology
Lady Irwin School
Canning Lane
New Delhi

Editor
Promila Theodore
Dept. of Biology
P.S. Higher Secondary School
Alagirisamy Salai
Karunanidhi Nagar.
Madras 600 078.

Distributed by
Orient Longman

Understanding Science—Biology 3

Acc No—15143

© 1986 Sangam Books (India) Pvt. Ltd.

First Published 1989
Reprinted 1989, 1990

ISBN 0 86131 658 4

Published by Sangam Books (India) Pvt. Ltd.
3-5-820 Hyderguda, Hyderabad 500 029 (A.P.

Distributed by
Orient Longman Limited
BOMBAY CALCUTTA MADRAS NEW DELHI
BANGALORE HYDERABAD PATNA GUWAHATI LUCKNOW

Cover Design by M.L. Saha

Design & Layout: Rajesh Gupta
for bukprint
H-5/9, Krishna Nagar
Delhi 110 051

Printed in India at
Taj Press
3024 Gali Ahiran,
B.G. Road, Delhi 110 006

Preface

The Understanding Science series conforms to the guidelines laid down by the NCERT. While planning these books, our aim has been not only to adhere to the syllabus but at the same time, present the relevant concepts in biology in a lucid and absorbing manner in order to stimulate the interest of the student.

Keeping in mind the level of understanding of the student and his inherent curiosity at this age, the facts have been presented as an answer to his queries on himself and his environment, and also on their interaction and interdependence. Relevant illustrations supplement the topics and reinforce the concepts.

Easy-to-do activities have been included to encourage the students to collect, tabulate and interpret data. Carefully planned exercises at the end of each chapter enable the student to recapitulate and help the teacher to assess the comprehension of student

September 1988

SHYAMLA MENON
KANCHAN L. MEDIRATTA
PROMILA THEODORE

Contents

1. Classification of Animals **1**

The Invertebrates
Vertebrates
Exercises

2. Common Examples of Some Phyla **24**

Amoeba
Hydra
Earthworm
Frog
Butterfly
Exercises

3. Food and Digestion **34**

Digestive System in Man
Digestive Disorders
Exercises

4. Respiration **41**

Respiration in Different Organisms
Respiration in Mammals
Respiratory Disorders
Exercises

5. The Circulatory System **47**

Composition of Blood
Functions of Blood
Circulation of Blood in Various Organisms
Blood Circulation in Mammals
Disorders of the Heart
Lymphatic System
Exercises

6. Excretory System **56**

The Excretory System in Lower Organisms
Excretory Organs in Mammals
The Process of Excretion
Skin as an Organ of Excretion
Exercises

7. Nervous System **63**

The Nerve Cell

- The Brain
- The Spinal Cord
- The Sense Organs
- *Exercises*

8. The Endocrine System 72
- Pituitary Gland
- Thyroid Gland
- Adrenal Glands
- Pancreas
- The Gonads
- *Exercises*

9. Reproductive System 77
- Sexual Reproduction
- Reproductive System in Human Beings
- Cell Division
- Growth and Development
- *Exercises*

10. The Muscular System 87
- Different Kinds of Muscles
- Muscular Disorders
- *Exercises*

11. Skeletal System 91
- Axial Skeletal System
- Appendicular Skeletal System
- Kinds of Joints
- Fractures and Diseases of Bones
- *Exercises*

12. Heredity, Variationand Evolution 97
- Heredity
- Variation
- *Exercises*

13. Useful and Harmful Animals 106
- Cattle
- Sheep and Goat
- Pigs
- Poultry
- Fishery
- Insects
- Microorganisms
- Harmful Animals
- *Exercises*

14. Conservation 117
- Soil Conservation

Water Conservation
Preservation of Forests
Conservation of Wild Life
Exercises

15. Diseases and Man 122

Diseases caused by Viruses
Bacterial Diseases
Other Microbes affecting Man
Exercises

1

Classification

You know the difference between living and non-living things. You must remember that the living beings are grouped into the Plant Kingdom and the Animal Kingdom. The latter includes all animals, irrespective of their habitat.

If you observe the animal life in and around your house or garden, you will find a large variety ranging from snails, earthworms to insects like mosquitoes, cockroaches etc. On the other hand if you explore the animal life in shallow ocean stretches, you will find animals such as sponges, starfish, corals, clams, lobsters,etc. You would be fascinated to know that even a drop of water can teach you a lot of biology. A stream, a pond or even a roadside ditch is full of tiny organisms which are strangely different from the larger animals.

You can well imagine how difficult it would be, to study such a wide and diverse range of animals. To avoid confusion the animals may be grouped into broad classes. The earliest known attempt at **classification** or *dividing the animal kingdom into categories showing relationships* was done by Aristotle in 384–322 B.C. He grouped animals on the basis of their habitat, i.e., those living in water as **aquatic**, those living on land as **terrestrial** while those that fly were called **aerial**.

Though this simplified matters to some extent the study of the animal kingdom was still not exactly easy. So the classification was done in greater detail, based on the similarity of form and by tracing the ancestral relationships. The branch of biology which deals with classification is known as **taxonomy**. You have read about the Swedish doctor Carolus Linnaeus who developed the *binomial system* of classification in 1753. This system gives a name to each living being, which is internationally used. These names are never duplicated and are generally descriptive, showing systematic relationships to other similar organisms.

The animal kingdom is broadly divided into two groups known as *Phylum*: **Achordata** and

Chordata. The former phylum includes animals with soft bodies and no vertebral column for e.g., lobsters, jelly fish, sponges, etc. This phylum is further subdivided into subgroups called **Protozoa** (unicellular) and **Metazoa** (multicellular). The subgroup Metazoa contains a number of phyla each having specific characteristics which differ from each other. Yet all these phyla have something in common i.e., they are backboneless, multicellular organisms. The phylum Chordata on the other hand consists of animals with a backbone, i.e., fishes, frogs, lizards, etc. One of the major subdivisions of Chordata is the subphylum **Vertebrata** which includes another wide variety of classes, e.g. Pisces, Amphibia, Mammalia, etc. In the vertebrates we find life in its highly specialised form. The present day classification is done in the following manner.

Phylum
Class
Order
Family
Genus
Species

If these categories are found insufficient, prefixes such as 'super', 'sub–' or 'infra–' are used.

The following example will help you to understand the basis of classification. The scientific name of the tiger you see in the zoo is *Panthera tigris*. This name links the tiger with other closely related forms e.g. *Panthera pardus*, the leopard. Tigers and leopards are from the same **genus** *Panthera* but are of different **species**, **tigris** and **pardus**.

Tigers and leopards hail from the same **family** as cats, namely *Felidae*. This family is related to other flesh eaters for example dogs, wolves, foxes, etc., and this is included with them in the **order** *Carnivora*. Like many other animals the carnivores suckle their young ones and thereby feature in the **class** *Mammalia*.

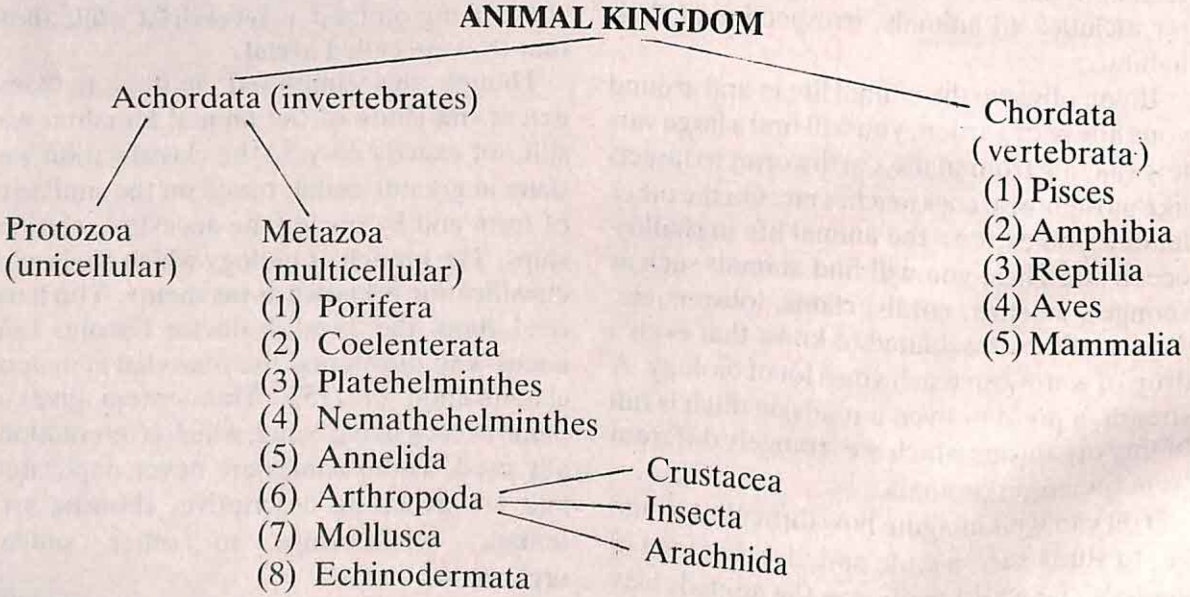


Fig. 1.1 A simplified chart showing classification of the Animal Kingdom

Mammals are related to other animals with a backbone and fall within the subphylum Vertebrata which is one of the major divisions of the phylum Chordata.

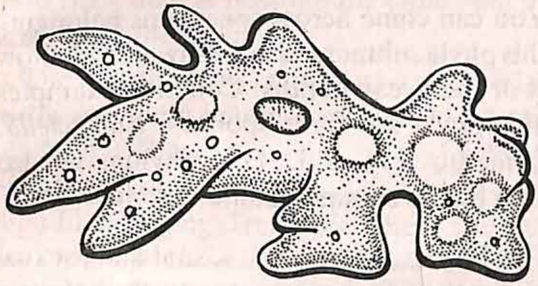
1.1 The Invertebrates

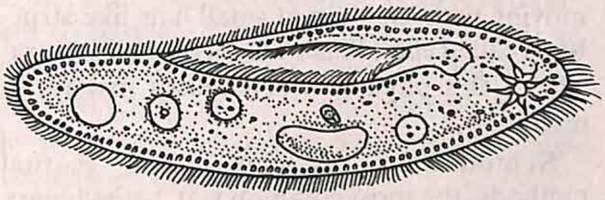
Invertebrates are divided into various phyla:

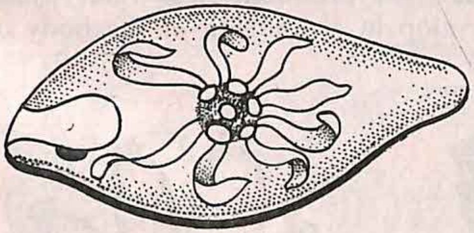
1. Protozoa,e.g.,Amoeba, Paramecium.
2. Porifera,e.g.,Sponges, Scypha.
3. Coelenterata,e.g.,Hydra, Jelly fish.
4. Platyhelminthes, e.g., Tapeworm, Liver fluke.
5. Nemathehelminthes, e.g., Roundworm, Hookworm.
6. Annelida,e.g.,Earthworm, Leech.
7. Arthropoda,e.g.,Cockroach, Lobster.
8. Mollusca,e.g.,Octopus, Snail.
9. Echinodermata,e.g.,Starfish, Sea lilly.

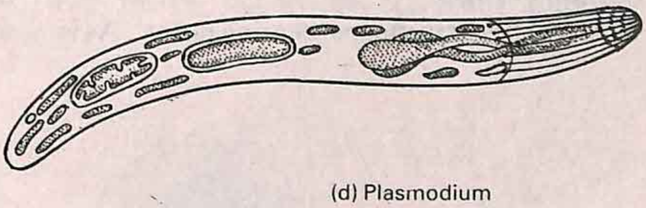
Phylum Protozoa

Protozoans are unicellular, microscopic animals. In them we find animal life in its most primitive form. The specialised cells of multicellular animals cannot live independently. But the protozoan cell is completely self-sufficient. All life functions occur within the tiny mass of protoplasm with the help of cell organelles. In most essential features, protozoans resemble the cells of which bodies of higher organisms are made. Functions, such


(a) Amoeba


(b) Paramecium


(c) Euglena


(d) Plasmodium

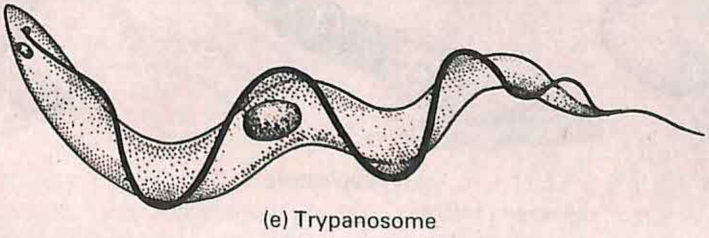

(e) Trypanosome

Fig. 1.2 Some members of the phylum Protozoa.

as feeding and water balance which are carried out by separate organs in higher animals are performed in specialised regions of the protoplasm in protozoans.

They can adapt themselves to a wide range f environments. They flourish in fresh water, marshes, streams and also in moist soil and hotsprings. Some of them are free living and some are parasites on the body of plants and animals, Fig. 1.2. Amoeba is a free-living form found in the sea, freshwater and soil, moving with the help of **psuedopodia** (false-feet). The Euglena shows a combination of characteristics of both plants and animals and moves with the help of a long threadlike structure called **flagellum**. Trypanosomes are parasites causing sleeping sickness in man. Paramecium is a free-living freshwater form, moving with the help of small hair-like structures called **cilia**. Plasmodium is another parasite of this phylum which causes malaria in man.

Reproduction takes place by asexual methods, the most common way being binary and multiple fission.

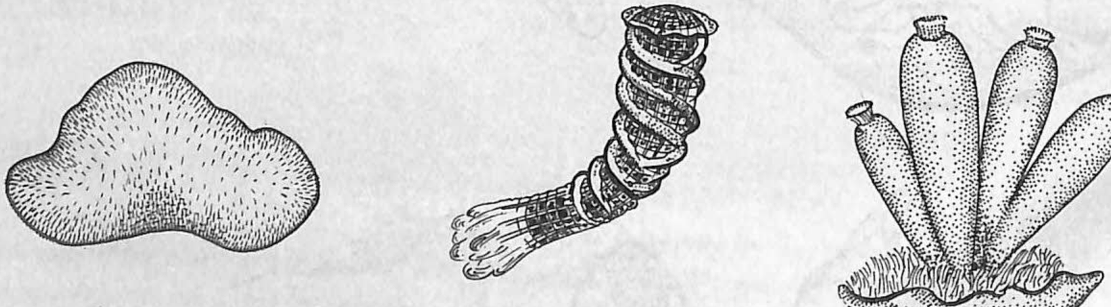
Phylum Porifera

The term porifera means 'bearing pores'. As is obvious from the name, members of this phylum have a large number of pores in their bodies. They lack specialised organs, but show a definite organisation with individual cells specialised for the functions of feeding, support or reproduction. Though these cells cannot exist independently, this increases the efficiency of the organisms.

The body consists of a hollow tube attached at one end to solid surfaces, such as rocks,and open at the other end. Currents of water flow through the tube and the pores and these organisms filter out particles of organic matter as their food. Also known as *filter feeders*, these animals do not have to go in search of food.

You can come across specimens belonging to this phyla submerged in freshwater, shallow seas or the ocean depths. Common examples of this phyla are Bath Sponges, *Euplectella*, *Scypha*, etc, Fig. 1.3. This phylum is also known by the common name, Sponges.

The Porifera show both sexual and asexual reproduction. In many sponges the capacity for asexual reproduction is considerable. New individuals are produced from buds which may develop in any region of the body or



(a) Bath sponge

(b) Euplectella

(c) Scypha

Fig. 1.3 Some members of the phylum Porifera

from fragments of the parent sponge. Sponges show remarkable powers of *regeneration*, i.e. power to grow back the lost part.

Phylum Coelenterata

Coelenterates are multicellular organisms which are more advanced than the sponges. They may be considered as the first animals in which the cells have been organised into tissues. Their body consists of tube-like central cavity known as **coelenteron** where food is digested and circulated. The cavity is lined by two layers of tissues, the outer layer is called **ectoderm** and the inner layer, **endoderm**. A single mouth opens at the anterior end. These animals can feed on a much greater range of food sizes than is possible for either the protozoans or the sponges.

The mouth is surrounded by a circle of **tentacles** and these help in capture and selection of food. These tentacles along with the ectoderm contain a large number of coiled tube-like stinging structures. These structures are unique to this phylum. The stinging structures help the coelenterates to acquire their food by paralysing or entangling the prey and also protects them from their enemies.

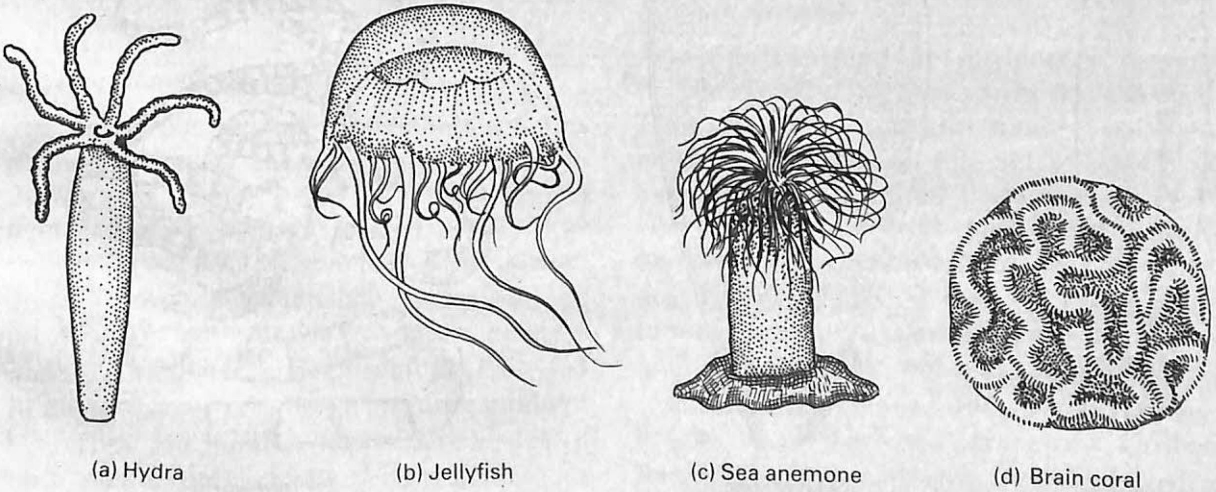
The members of this phylum may reproduce asexually by budding or sexually. This phylum too possesses the power of regeneration and grows back the lost part in a remarkably short space of time.

The coelenterates are mainly marine. Hydra being an exception is a freshwater form. Other common examples are jellyfish, sea anemone, brain coral, etc. Fig. 1.4.

Phylum Platehelminthes

This phylum enjoys a higher level of organisation than coelenterates. Apart from a specialised head region this phylum shows a major difference from the coelenterates. In the members of this phylum, the tissues are organised into organs with specialised functions. Several organs combine as an organ system to perform a single life activity such as feeding or reproduction. Digestive, reproductive, excretory and nervous systems are all developed to some degree in at least some representatives of this phylum.

Platehelminthes means 'flatworms' and as the name suggests includes different types of flatworms. Some examples are planarians, liver flukes, tapeworms, etc. They are such



(a) Hydra (b) Jellyfish (c) Sea anemone (d) Brain coral

Fig. 1.4 Some common coelenterates.

diverse forms that they merit a separate treatment. Let us study these forms in some detail, of which few are free living and most are parasites.

Planarians

The members of this class are free living. They have an elongated form, with a well developed head with sideways projections, Fig. 1.5. (a). They are commonly found crawling over the bottom of slow streams, lakes or ponds feeding on small invertebrates,e.g.,earthworms, water fleas and snails.

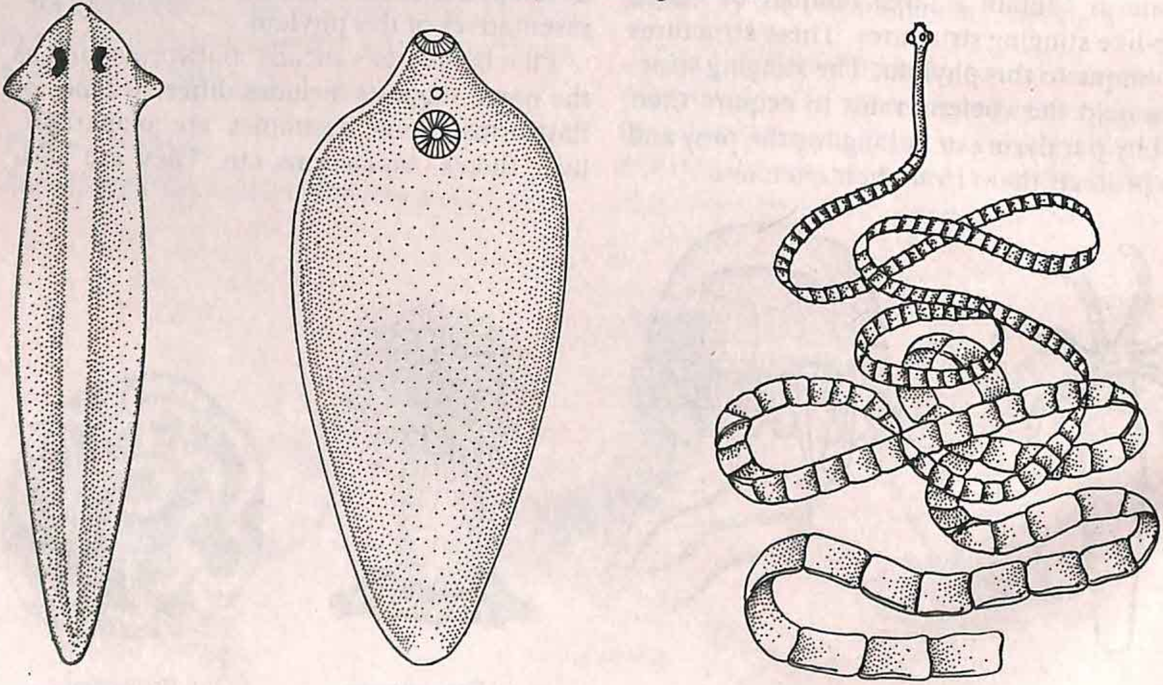
Planarians have a well developed head with two eyes which can distinguish between light and dark conditions. They can reproduce sexually or asexually (by regeneration process).

Liver flukes

This class of animals are parasitic in nature. **Their** structure is therefore modified to suit the mode of living. They live inside the host's body with **suckers** as a means of attachment to the host, Fig. 1.5. (b). An **oral sucker** surrounds the mouth and a **ventral sucker** is present on the ventral (lower) surface of the body. They feed on cells, blood, mucous, or tissue fluids of the host.

Tapeworms

These are parasitic forms living in the small intestine of vertebrates, Fig. 1.5. (c). They differ from the other two examples in their total lack of a digestive system. Ribbon-like in form, they have a knob-like structure, **scolex**, at the anterior end. The scolex has **suckers** and **hooks** with which the worm attaches itself to the wall of the intenstine of host. Pigs and cows are infested with these worms and when human beings eat pork or beef which has not been cooked properly, they get infested with this parasite.



(a) Planaria

(b) Liverfluke

(c) Tapeworm

Fig. 1.5 Examples of the phylum Platehelminthes

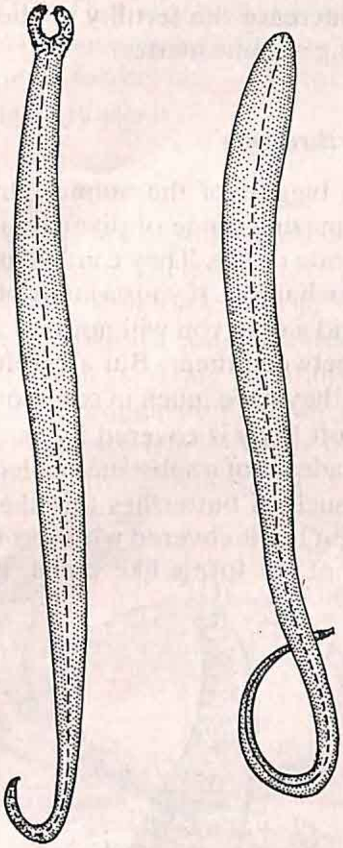

(a) Hookworm (b) Ascaris

Fig. 1.6 Some common nematodes

Phylum Nemathehelminthes

The nematodes, as the members of this phylum are called, are more complex than the flatworms. While the better known nematodes are parasitic, a vast majority of them are free-living. Nematodes are dependent on water even when living in the soil, and are common in places where organic matter is found. Perhaps these requirements have led to many species adopting a parasitic mode of life. They are highly successful parasites of both plants and animals. Many nematodes show an alternation between parasitic and free-living forms. The nematodes have round and unsegmented body, tapering at both the ends, Fig.1.6.

The mouth is at the extreme tip of the anterior end and is guarded by three lips, and continues into a tube with regional specialisation to perform digestive activities. The mouth is opened to allow the intestinal contents of the host into the tube, from where it is pushed into the intestinal regions of the worm. As they are present in the intestine of the host their body has a covering which is resistant tc digestive juices.

In one respect this phylum is unique. There is a total *lack* of either flagella or cilia. The male and female are separate, i.e., the members are unisexual. Some common examples are Roundworm (*Ascaris*, which lives in the intestine of pigs, horses and man), *Trichina* worm produces a painful disease in man called Trichinosis. Hookworms are common in tropical regions. They enter the body through the hands and soles of the feet, and feed on blood from the intestinal wall of the host. This causes considerable loss of blood and therefore the victims suffer from anemia.

Phylum Annelida

Annelida is an important phylum representing the third major type of worm organisation. They are found in pastures, muddy shores and marshes. They have ring-like markings or *annuli* on the external body surface, from which the name of the phylum is derived (*anellus* means 'a little ring'). Annelids have cylindrical and segmented body with a straight tubular digestive system passing through the middle of the body.

Some of the members of this phylum have bristles on the underside of the body. Others have sideways projections of the body wall in each segment, called **parapodia**. These parapodia too bear bristles. These bristles help in locomotion. They possess a well developed digestive, circulatory and nervous system which shows a distinct advance from the flatworms.

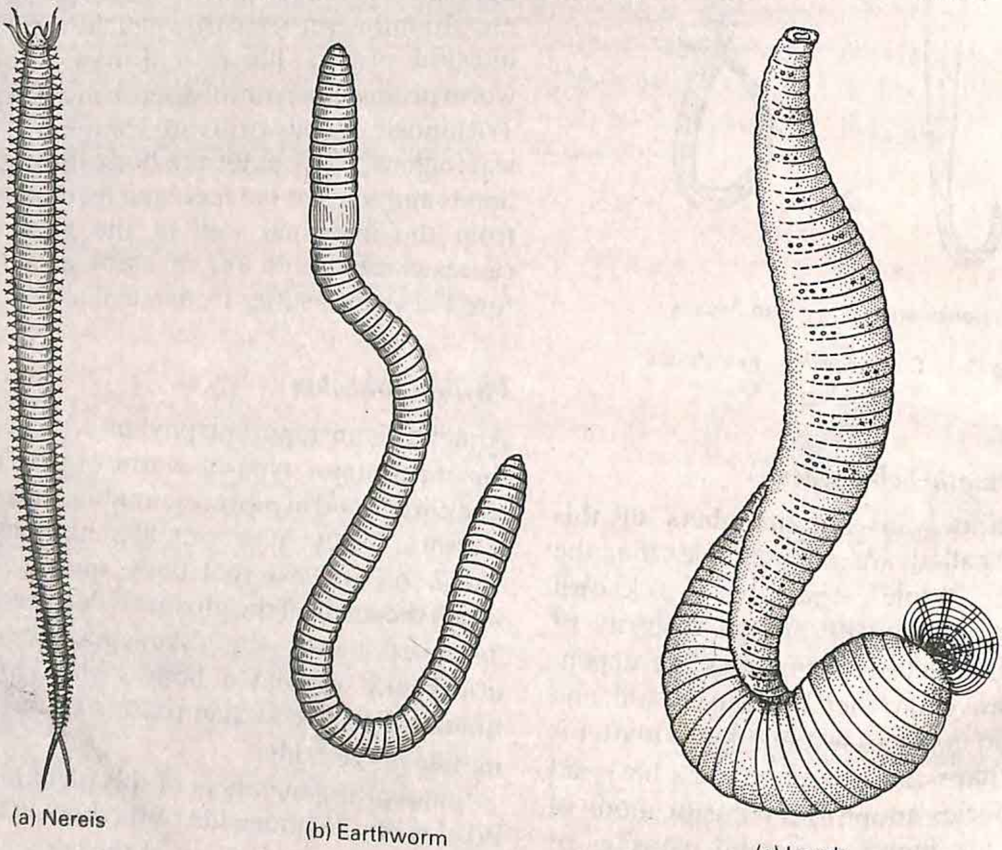
Annelids can be bisexual (*hermaphrodites*) such as, earthworms or unisexual such as leeches, Fig. 1.7. Leeches are parasitic annelids and earthworms and *Nereis* are free-living. The leeches have suckers with which they attach themselves to the exposed parts of animals and man and suck their blood. The leeches are found in large numbers in tropical rain forests.

The earthworm is an economically useful worm. It bores holes in the soil and thus loosens it and allows air spaces in the soil. They also increase the fertility of the soil by decomposing organic matter.

Phylum Arthropoda

This is the biggest of the animal phyla and shows an amazing range of diversity in structure and mode of life. They can live in nearly every known habitat. If you casually observe a butterfly and a crab you will not find much in common, between them. But a careful study shows that they have much in common.

(i) Their soft body is covered by an external skeleton made up of a substance called **chitin**. In insects such as butterflies this skeleton is thin and light but is covered with wax to make it waterproof. In forms like crabs, it is thin



(a) Nereis

(b) Earthworm

(c) Leech

Fig. 1.7 Examples of the phylum Annelida

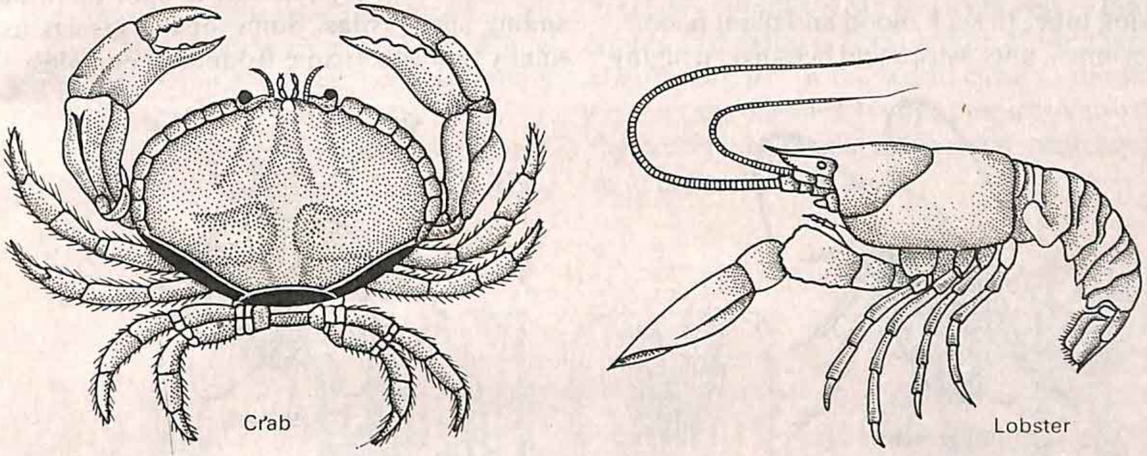
and hard. (ii) They all possess jointed legs and their body is segmented. Owing to its diversity this phylum is further classified as Crustacea, Arachnida and Insecta.

Crustacea

Majority of the species are marine but some live in fresh water. Their body is covered by a hard and thick skeleton except at the joints. They have two pairs of **antennae** (feelers) and many pairs of legs. They generally feed on organic matter, animal or plant, alive or dead. Crabs and lobsters belonging to this group, are considered to be delicacies in some parts of the world, Fig. 1.8. (a).

Arachnida

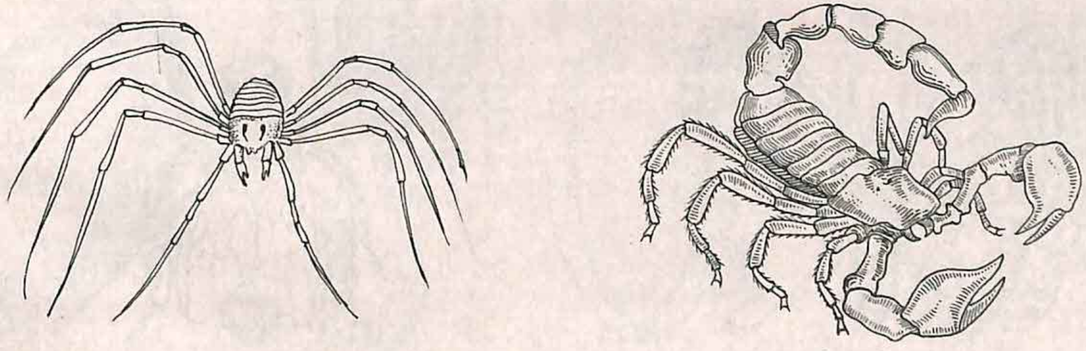
The arachnids can be easily distinguished from the crustaceans and insects by the absence of antennae and presence of four pairs of legs, Fig. 1.8 (b). Spiders, which belong to this group, have fangs on either side of the mouth. With these they inject poison into the prey and feed on it. Scorpions on the other hand have pincers with which they catch the prey. Some scorpoins have a poisonous sting in their tails.



Crab

Lobster

(a) Crustaceans



Spider

Scorpion

(b) Arachnids

Fig. 1.8 The phylum Arthropoda

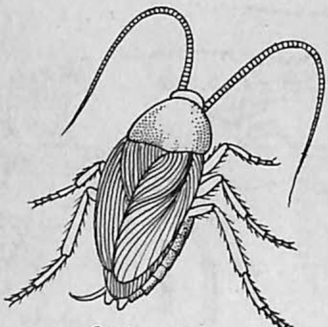
Insecta

The class insecta is the most numerous of the great phylum Arthropoda. You are all familiar with many insects such as butterflies, cockroach, mosquito, ant, wasp, bee, housefly, etc., Fig. 1.8 (c).

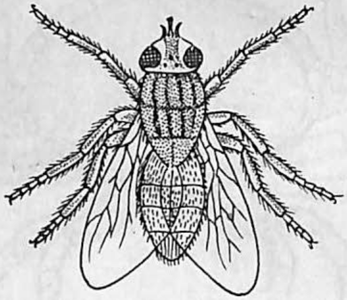
Insects are found in a wide range of habitat. They have three separate body regions, head, thorax and abdomen. Most of them have two pairs of wings and three pairs of jointed legs. Their mouth parts are adapted to their mode of feeding. In butterflies and moth, mouth parts form a tube, helping in sucking nectar from flowers. The mosquitoes also have a sucking tube, to suck blood and plant juice.

Termites, ants, wasps and bees live in highly organised communities. Members of a colony show certain physical differences from one another. Each type has to carry on its own specific task. There is division of labour among the members of this group. The queen is much larger than the other types and its task is only to lay eggs. The male bees (**drones**) fertilise the queen bee and the **worker** bees collect nectar, prepare honey and build the hive.

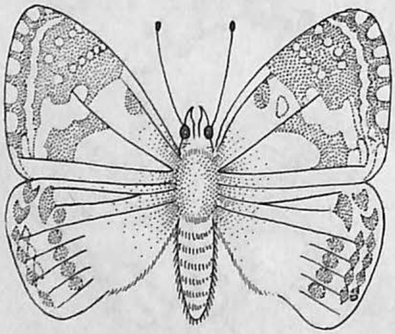
Insects have many enemies. In order to protect themselves they adopt various methods of camouflage and mimicry. The brown grasshopper has the same colour as the ground in which it lives. Stick insect looks like a small stick and it is very difficult to spot them out among small twigs. Some of the insects use smelly fluids to escape from their enemies.



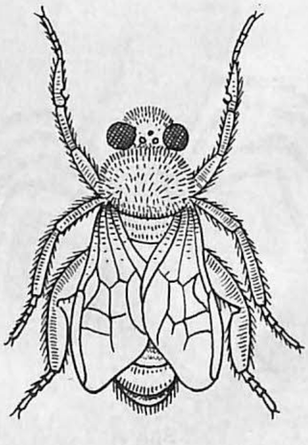
Cockroach



Housefly



Butterfly



Bee

(c) Insects

Fig. 1.8 The phylum Arthropoda.

Phylum Mollusca

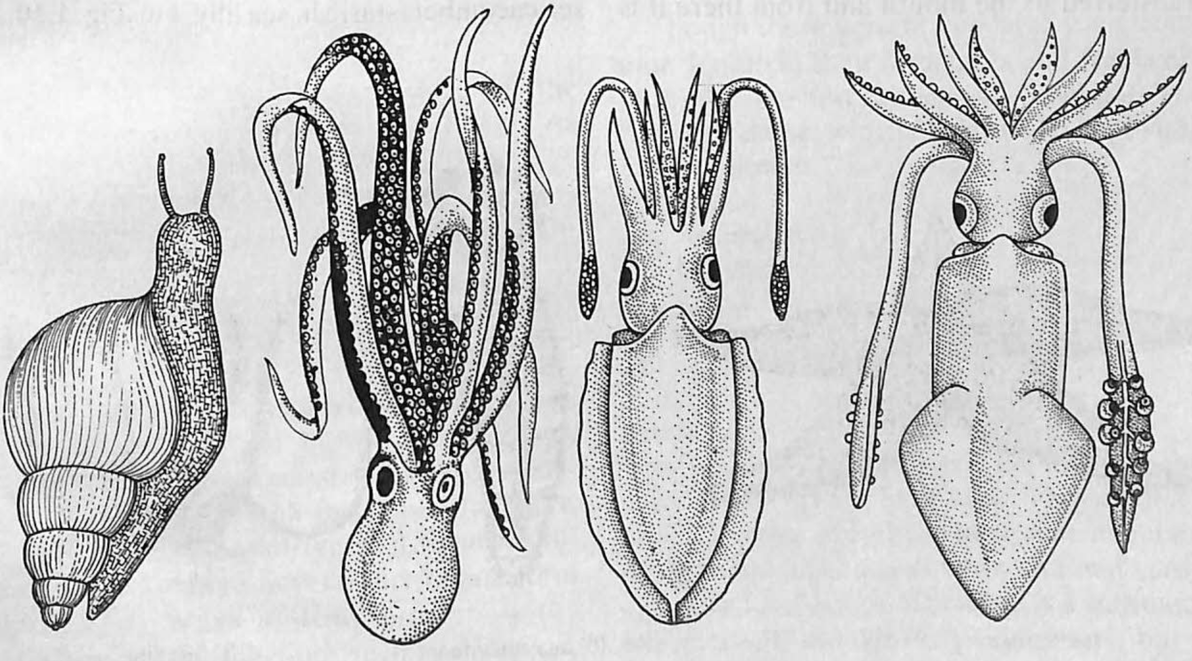
This phylum originated in the sea and a vast majority of its members are marine. Some members of this group have invaded freshwater and very few are terrestrial forms. They have a pair of tentacles and eyes on a well developed head. They have soft bodies, protected by a hard shell which is made up of calcium carbonate.

The shell is secreted by the outer covering of the body called **mantle**. The shells may be in a single piece (univalved), or in two pieces (bivalved). These animals retreat into their shell when threatened by their enemies. Most of them possess a muscular foot which is an extension of the body tissues. This foot is modified for a range of functions including movement, burrowing and digging.

The snail, an example of univalved mollusc, feels the food with the tentacles, Fig.1.9. They eat earthworms, algae, etc. The bivalved molluscs have two openings in the shell through which water is circulated, alongwith food particles, into the body. The food is filtered out and the water is thrown out of the body.

The octopus, squid and cuttle fish, also members of this group,have ten arms attached to the head Fig.1.9. These arms have suckers which are used in catching their prey. These animals possess ink sacs which are used to spray ink into the water. This ink causes the enemy to lose sight of these animals temporarily and they escape.

Marine molluscs such as mussels, clams, squids and octopus form a part of the diet in almost all parts of the world close to the sea. Oysters are useful not only as food but also for the pearls they produce due to the presence of sand grains in their shell.


(a) Snail

(b) Octopus

(c) Squid

(d) Cuttlefish

Fig. 1.9 Some common molluscs

Phylum Echinodermata

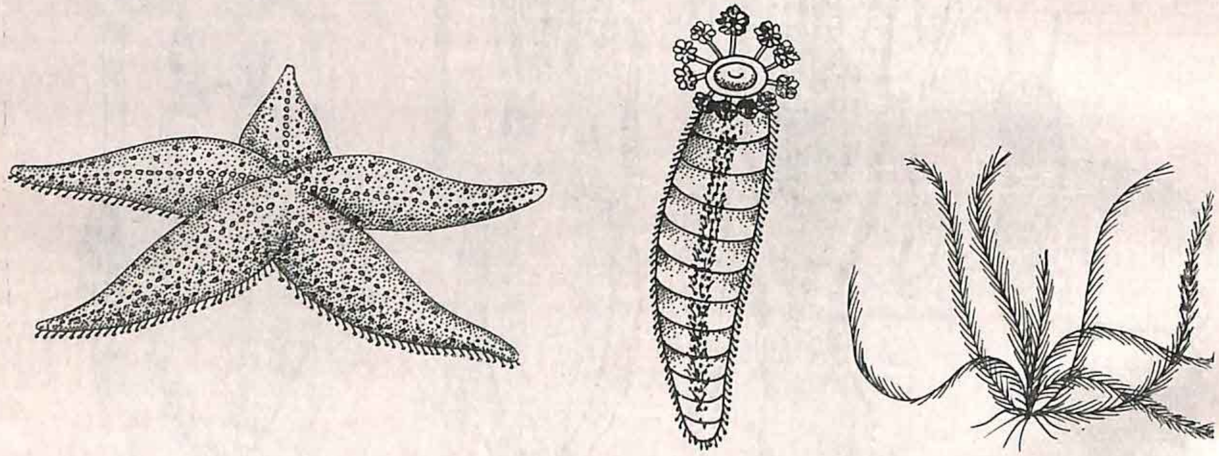
They are chiefly bottom-dwelling animals and are present in marine or brakish water. This phylum is immediately recognisable from their symmetry. The body can be divided into five parts or arms radiating from a central axis. The body wall has an internal skeleton. In many echinoderms the skeleton bears numerous spines which protrude above the outer surface, giving it a spiny look. The name of the phylum is derived, from this feature, it means 'spiny-skinned'.

The radiating arms have numerous tube-feet, **podia** which may be used for feeding, locomotion or for sensing the external environment. The podia have broadened sucker-like tips and when these touch the prey, its centre is withdrawn producing a slight vacuum. The prey thus sticks to the podia due to suction. The prey caught by the podia are transferred to the mouth and from there it is transferred to the alimentary canal or **coelom** in the body cavity where other organs are also present.

The different types of echinoderms may feed on a varied range of food material, e.g., sea-weed, small algae, clams, mussels and oyster. In fact, the starfish has a rather destructive effect on oyster beds. A single starfish may eat as many as 20 oysters in a day. The coral-eating crown of thorns starfish is notorious for its harmful effects on large areas of the great Barrier Reef (a coral reef.)

The problems of predation by echinoderms is made worse by the fact that they are difficult to kill. They have considerable powers of regeneration. When the starfishes are chopped up in an attempt to kill them, it results in an increase in the population! Each chopped part grows back the lost portions to give new individuals.

Some common examples of this class are the sea cucumber, starfish, sea lilly, etc., Fig. 1.10.



(a) Starfish

(b) Sea cucumber

(c) Sea lilly

Fig. 1.10 Phylum Echinodermata

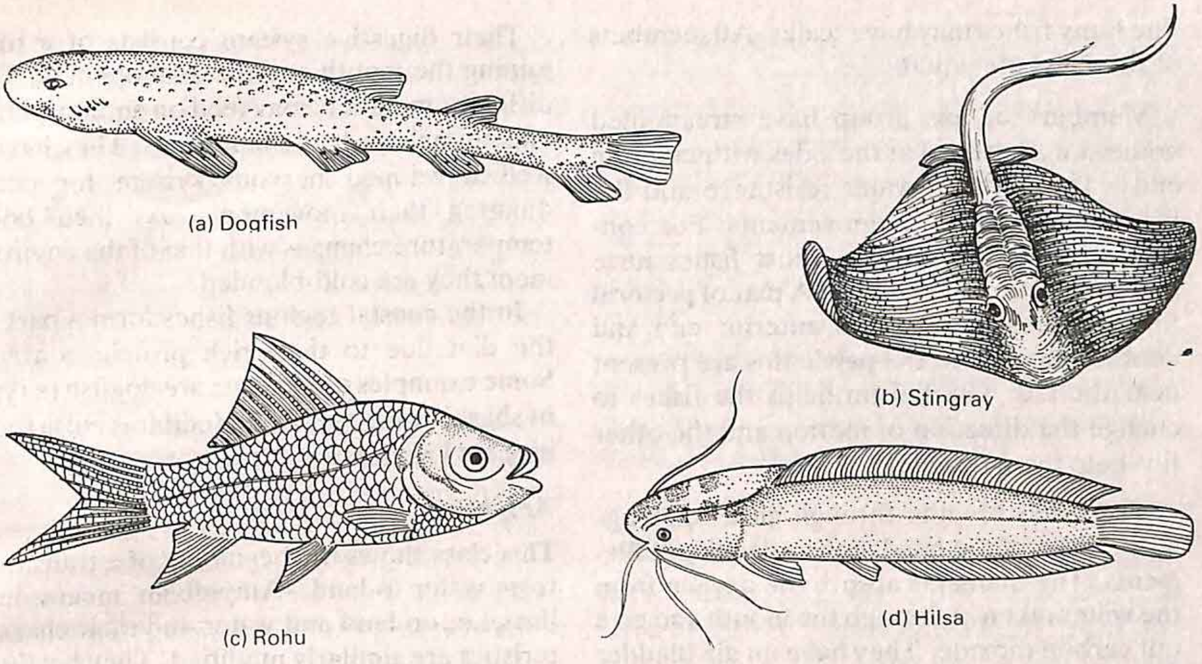

(a) Dogfish
(b) Stingray
(c) Rohu
(d) Hilsa

Fig. 1.11 Examples of the class Pisces

1.2 Vertebrates

This forms the major subphylum of the phylum Chordata of the Animal Kingdom. As you already know vertebrates are animals possessing a backbone. This backbone encloses the spinal cord which coordinates their movements. They have a strong internal framework of bones called **skeleton** which supports the body and allows the animals to move with agility.

Vertebrates are distinguished from the invertebrates not only by the presence of a backbone or **vertebal column** but by other features as well. Cells with specialised functions form **tissues**. Different types of tissues combine to form **organs**. Several such organs form the various **organ systems** present in the vertebrates. The functions such as digestion, breathing, etc., are carried out by separate organ systems.

Though these vertebrates have some common features, their structures and forms are such, that are best suited to their habitat. The different classes which fall into this subphylum are as follows:

(1) Pisces
(2) Amphibia
(3) Reptilia
(4) Aves
(5) Mammalia

Pisces

This class of animals were the first on this earth with a proper backbone. They exhibit a wide diversity of form. The earlier members of this class lacked jaw-bones and had cartilage instead of bones. Cartilage is a substance which is stiff enough to give support, but is more flexible than bone. Sharks and rays are cartilaginous fishes, but the former has jaws.

The bony fishes may have scales. All members of this class are aquatic.

Members of this group have streamlined bodies,i.e., flattened at the sides with tapering ends. This reduces water resistance and the fishes can make swift movements. For controlling their movements, most fishes have paired structures called **fins**. A pair of **pectoral** fins are present near the anterior end and another pair called the **pelvic** fins are present near the tail. The tail fin helps the fishes to change the direction of motion and the other fins help them to swim.

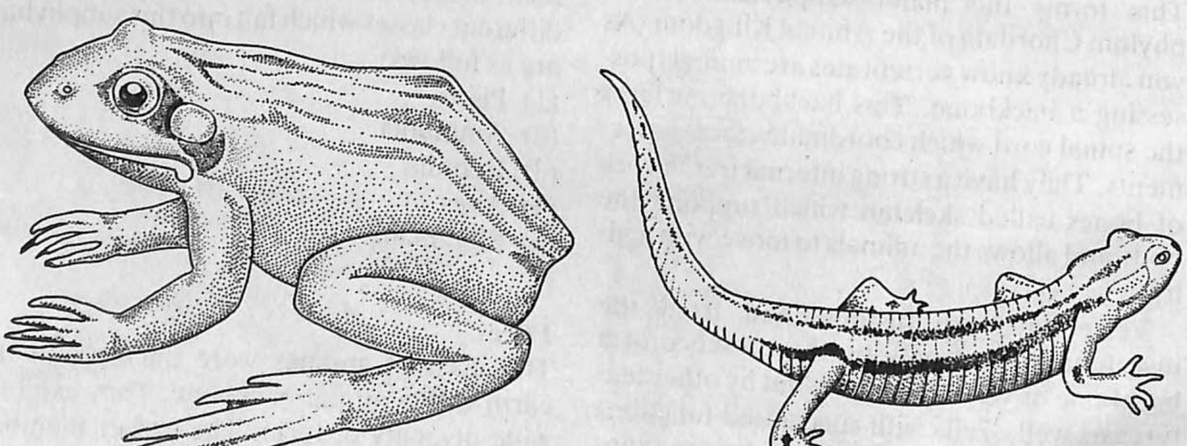
The fishes breathe through **gills**, openings at the sides of the head, covered with **gill filaments**. The filaments absorb the oxygen from the water taken in through the mouth and give out carbon dioxide. They have an air-bladder filled with gases which helps them to rise to the surface of water or sink to the bottom by regulating the amounts of these gases.

Their digestive system consists of a tube joining the mouth and the anal opening. The different members may feed on aquatic plants and animals such as small fishes. They have a well developed nervous system for coordinating their movements. As their body temperature changes with that of the environment,they are cold blooded.

In the coastal regions fishes form a part of the diet due to their rich protein content. Some examples of this class are dogfish (a type of shark), sting ray, Rohu (edible), Hilsa (edible) etc Fig. 1.11.

Amphibia

This class shows the beginning of a transition from water to land. 'Amphibian' means dual lives,i.e., on land and water and their characteristics are similarly modified. They lay their eggs in water and the young fish-like **tadpoles** lack limbs and breathe through gills to suit their aquatic habitat.



(a) Frog

(b) Salamander

Fig. 1.12 Class Amphibia

The adult frog, on the other hand has lungs for breathing and limbs for locomotion and is truly *amphibious* (capable of living on land as well as in water). The hind legs are long and strong so as to help in leaping movements. The feet are modified to serve as paddles for swimming. The skin is moist and slimy and helps in breathing. Frogs have certain structures called tympanic membranes which help them to hear.

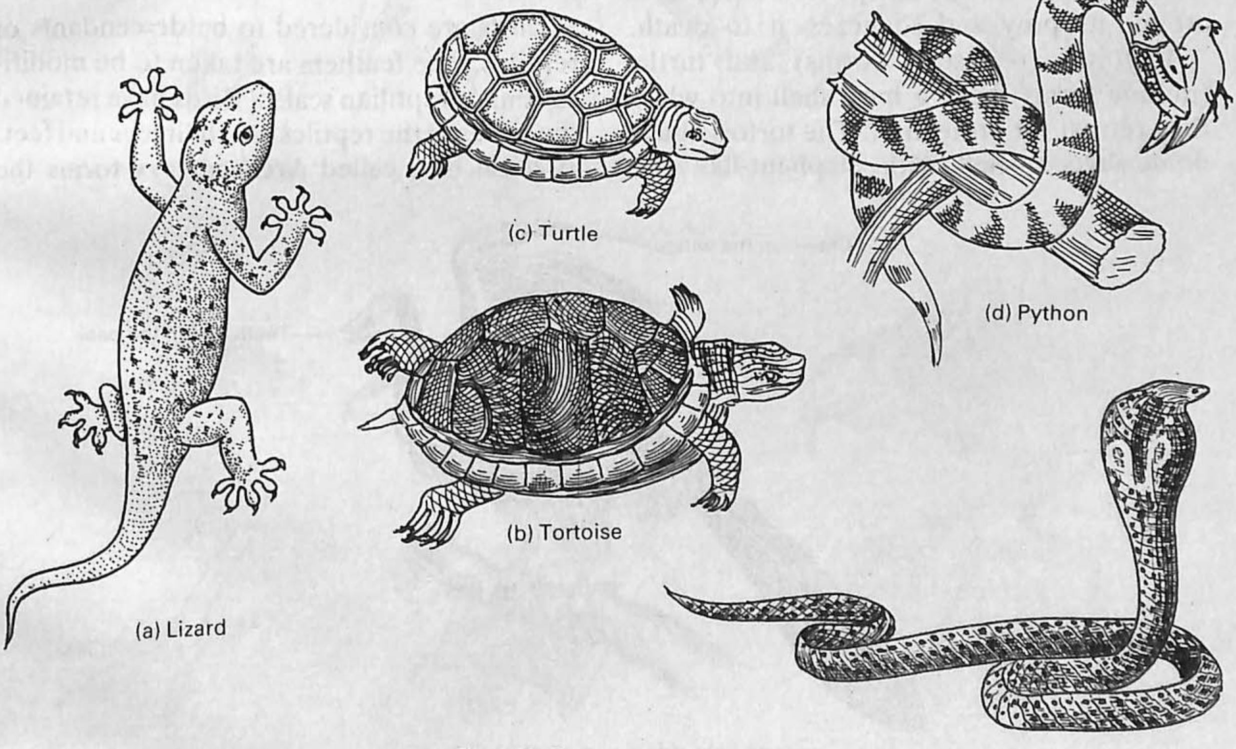
While the tadpole is exclusively herbivorous the adult frog feeds on worms and insects. The tongue is attached at the front and the free end is sticky and rests in the mouth. When some insect is around, the frog flicks out its tongue and the insect gets stuck to the sticky end. The frog then pulls the tongue back into its mouth.

The amphibians cannot maintain their body temperature and thus they cannot withstand adverse climatic conditions. Like most cold blooded animals they hide under rocks and crevices and the rates of all body activities such as breathing, digestion,etc.,are reduced. This process is known as **hibernation** and it occurs during the winter months when there is scarcity of food as well.

Some members of this group can change the colour of their skin to confuse their enemies and escape. Examples of this group are frogs, toads and salamander, Fig. 1.12.

Reptilia

Lizards, snakes, turtles, tortoises are members of this class, Fig. 1.13. They generally have elongated bodies with a head, trunk and a tail. Lizards and turtles have a pair of limbs



(a) Lizard

(b) Tortoise

(c) Turtle

(d) Python

Fig. 1.13 Some common reptiles

ending in claws while the body of the snake is covered with scaly outgrowths on the underside (different from those in fishes) which help them to have a grip on the ground. Snakes can be identified from the arrangement of the scales present on their heads.

The lizard, when stalked by an enemy can leave its tail behind which continues to wriggle even after the lizard has escaped. The snakes are unable to hear but they can pick up the sound vibrations produced by the moving feet and hastily wriggle away. A certain example of this class, chameleon, is able to change the colour of its skin with the changing surroundings.

Poisonous snakes are few and can be easily recognised from their external features. These snakes have poison-sacs on either side of the head. The poison flows into sharp tooth-like structures called **fangs** and is injected into the victim through a bite. The python wraps itself around its prey and squeezes it to death.

Tortoises (terrestrial forms) and turtles (marine forms) have a hard shell into which they retreat for protection. The tortoise has a dome-shaped shell with elephant-like feet adapted for living on land ,while the turtles have flattened shells and flipper-like feet which helps them to swim. Tortoises are mainly herbivorous while the turtles prey on fish and water birds.

Animals of this class are useful to man in various ways. Lizards prey on insects like mosquitoes and cockroaches and help man. Snake leather earns us foreign exchange. Turtle meat is considered a delicacy.

Aves (Birds)

The class Aves consists of a variety of birds, inhabiting a wide range of environments from the ice-capped polar regions to the tropics. The members of this class show a remarkable uniformity of basic structure. As they are warm-blooded animals, their body is covered with feathers, so as to maintain a constant body temperature. In this feature they differ from the earlier classes of vertebrates.

Birds are considered to be descendants of reptiles. The feathers are taken to be modifications of reptilian scales. Birds have retained the scales of the reptiles, on their legs and feet. A fossil bird called **Archeopteryx** forms the

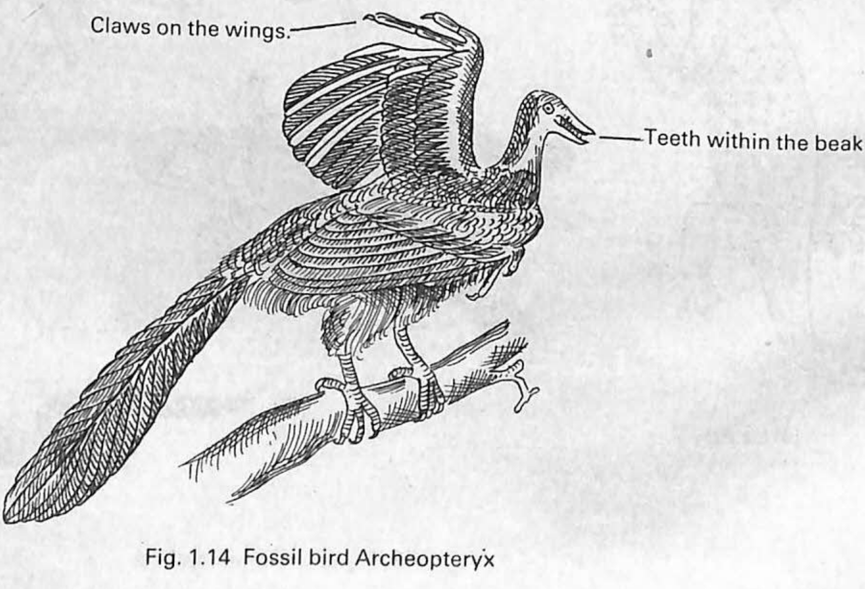
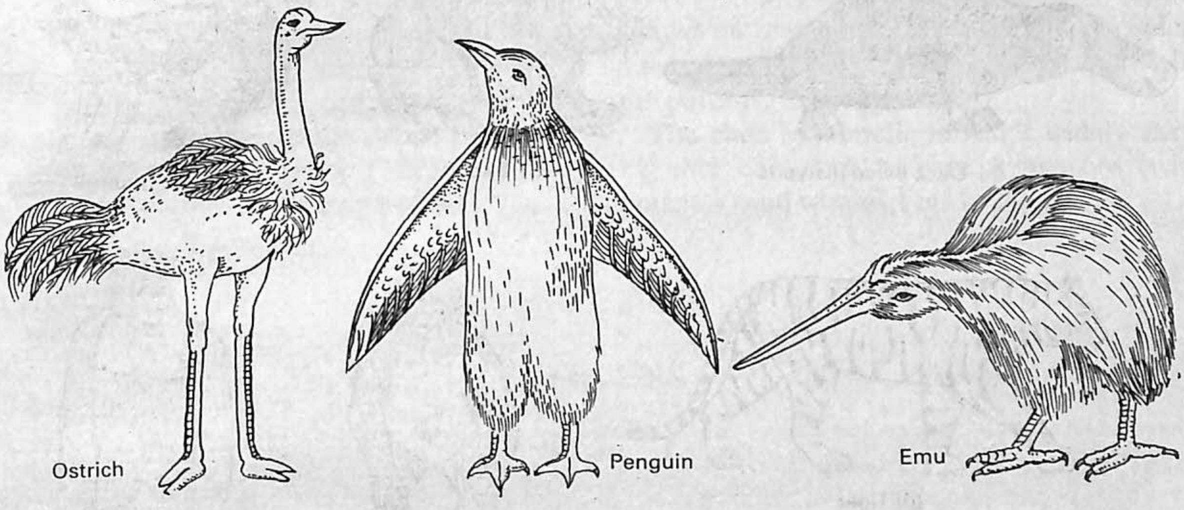


Fig. 1.14 Fossil bird Archeopteryx

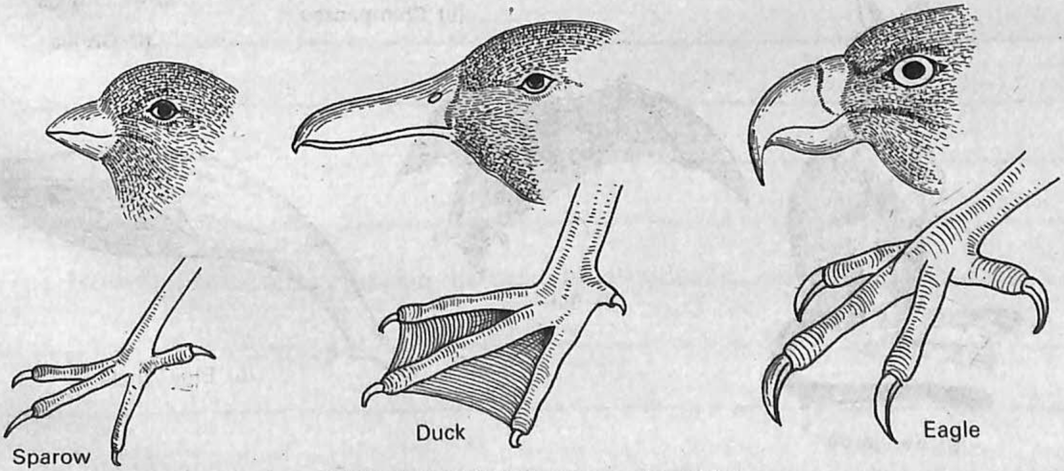
link between these two classes, Fig. 1.14. This fossil bird had wings (like birds) with claws on them and teeth (like reptiles) in its beak. There were scales on its legs. From all these evidences it was concluded that the birds descended from the reptiles.

Birds like the emu and ostrich which live on land, have larger bodies than those that fly. The flying birds have hollow bones so that their body is light. They have a streamlined body to reduce air resistance. The beaks and feet of birds show modifications according to the food they eat and their habitat.

Hawks, eagles and owls have hooked beaks and sharp claws to help them tear the flesh of the animals and birds they prey on. Sparrows have short beaks for crushing seeds and claws to help them to perch and walk. The ducks have flat beaks called **bills** with which they seive out the worms from the mud. They have webbed feet which they use for swimming.



(a) Birds that cannot fly



(b) Beaks and feet of some common birds.

Fig. 1.15

Mammalia

Mammals are the most evolved of all the vertebrates. Their name is derived from the word "mammae" which means milk-secreting organ. All members of this class have mammary glands which produce milk for nourishing the young ones. They are warm blooded and are covered with hairs, which helps to maintain a constant body temperature.

This class of animals differ from the earlier classes in another important feature. The babies of mammals develop inside the mother's body and at the end of a certain period of time they give birth to the live young ones. The baby is then suckled at the breasts of the mother. The only exception to this rule

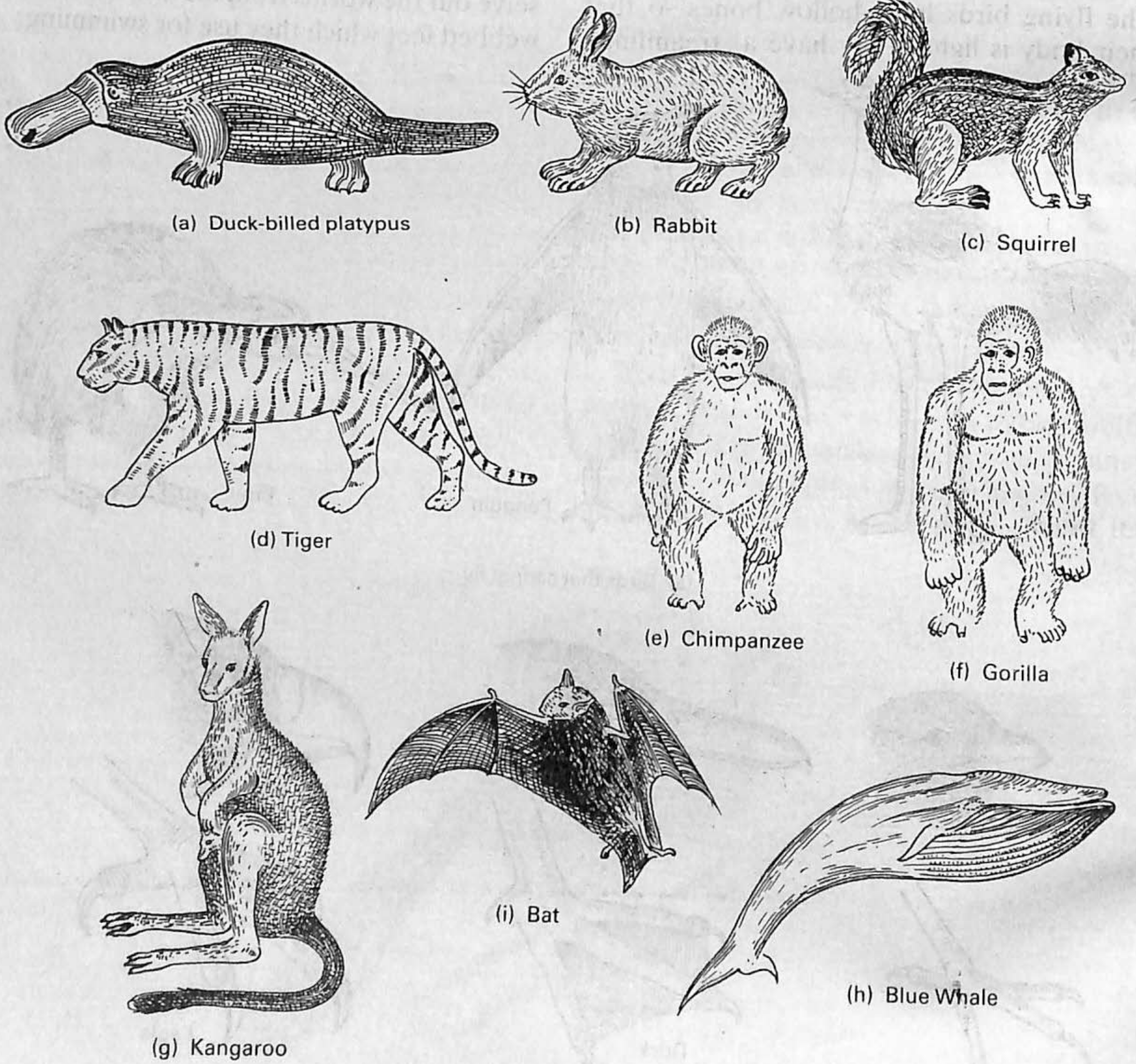

(a) Duck-billed platypus
(b) Rabbit
(c) Squirrel
(d) Tiger
(e) Chimpanzee
(f) Gorilla
(g) Kangaroo
(h) Blue Whale
(i) Bat

Fig. 1.16 Mammals

is the duck-billed platypus, which lays eggs but has mammary glands.

Mammals, like birds, are considered to be the descendants of reptiles. The hairs present on their bodies are supposed to be the modifications of the scales present in reptiles. The teeth are also modified to suit the food habits. The teeth in mammals are divided into **incisors**, **canines**, **premolars** and **molars**.

In herbivores like rabbits and squirrels, the incisors are well developed to help them gnaw at the leaves and fruits of plants. The canines are sharp and jutting in carnivores like tigers and cats so that tearing flesh becomes easy for them. The digestive system of these mammals also varies with the nature of the food they eat. The food canal in herbivores is long as it takes a longer time to digest plant material. The cud-chewing cows have a four chambered stomach ,which sends small lumps of food which these animals chew at leisure.

A subdivision of this class is the group called **Primates**. It includes the apes, i.e., gorilla, chimpanzee, baboon, etc., and man. These animals are distinguished from the rest due to their well developed brain. Most of them have an erect posture and an endoskeleton to suit the purpose. Primates have a reduced sense of smell but the sense of sight is more developed. They bear fewer offsprings and for a considerable period the young ones are protected by the parents.

The class Mammalia includes widely varying members such as bats, kangaroos (with pouches) and whales, Fig. 1.16.

EXERCISES

Section I

1. (i) What is the need for classification? ____________________

____

____

____

____

(ii) How do protozoans perform the various activities? ____________________

____

____

____

____

2. (i) Explain how coelenterates are superior to sponges...

(ii) Why are the sponges given the name 'Porifera'?

3. (i) How does man get infested with tape worms?

(ii) Which parts of the annelid's body help it to move?

4. (i) Butterflies and crabs are similar in that, they have:

(ii) How are the mouth parts of insects adapted to suit their feeding habits?

(iii) How do insects protect themselves from their enemies?

5. (i) In what way are molluscs useful to man?

(ii) How did the phylum Echinodermata get its name and what is its characteristic feature?

(iii) The problems of predation by echinoderms is difficult to handle. Explain.

Section II

1. (i) Give the distinguishing features of vertebrates.

(ii) Fishes have bodies adapted for their aquatic habitat. Explain.

Acc No - 15143

2. (i) The frogs catch their prey by:

(ii) What are the ways employed by lizards and chameleons to escape from their enemies?

3. (i) What led scientists to conclude that birds are descendants of reptiles?

(ii) Write briefly how the feet and beaks of birds are modified according to their feeding habits and habitat.

4. (i) Mammals are the most evolved of all the vertebrates. Explain briefly.

(ii) Give a brief account of how the teeth in mammals are modified according to their food habits.____

____

____

____

5. Choose the right answer

(i) Tigers and leopards hail from the same (species/genus).
(ii) Tigers and (cats/dogs) belong to the same family Felidae.
(iii) The (class/order) Carnivora includes all flesh eaters.
(iv) The class (Amphibia/Mammalia) suckle their young ones.
(v) Subphylum Vertebrata is the major subdivision of the pylum (Achordata/Chordata).
(vi) The unicellular (metazoans/protozoans) belong to the phylum Invertebrata.
(vii) (Trypanosomes/Amoeba) cause sleeping sickness in man.
(viii) Plasmodium is responsible for causing (malaria/dysentery) in man.
(ix) Special structures called (nematocysts/mesogloea) help hydra to procure food and protect itself from enemies.
(x) The name platehelminthes means (flatworms/roundworms).
(xi) Liver flukes attach themselves to the host's intestine by means of (hooks/suckers).
(xii) Arachnids can be distinguished from crustaceans and insects by the (absence/presence) of antennae and the (absence/presence) of four pairs of legs.
(xiii) Octopuses and squids use (ink sacs/poison sacs) to escape from their enemies.
(xiv) The snail uses its (podia/tentacles) to catch its prey.
(xv) The fishes breathe through (gills/lungs).
(xvi) Snake move with the help of (scaly outgrowths/lungs).
(xvii) Emu and ostrich are (large/small)birds adapted for living (on land/in water).
(xviii) (Mammae/Chaetae) are the organs which produce milk in mammals.
(xix) Primates have well developed sense of (smell/sight) and an (endoskeleton/exoskeleton) to support an erect posture.

2

Common Examples of Some Phyla

2.1 Amoeba

Amoeba is a free living fresh water form, found in abundance at the bottom of stagnant waters of lakes and ponds and also on the surface of the leaves of aquatic plants. Its body is like a small mass of living jelly without a definite shape. This single cell of amoeba can perform all activities. The constant flowing movement of the cytoplasm exerts pressure on the thin cell membrane producing a large number of projections called **pseudopodia** i.e., false feet.

The amoeba moves in water with the help of these pseudopodia. Protoplasm flows in the direction of movement, constantly changing the shape of the amoeba. It feeds on small organic particles such as bacteria, small algae and fungi by giving out a pair of pseudopodia which encircle the food and then engulfs it, Fig. 2.1. The food particle alongwith a drop of water becomes the **food vacuole** and gets digested in the vacuole. Digested food is absorbed by the cytoplasm and undigested food particles remain in the vacuole and are

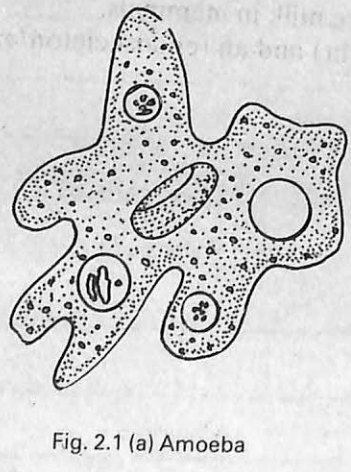


Fig. 2.1 (a) Amoeba

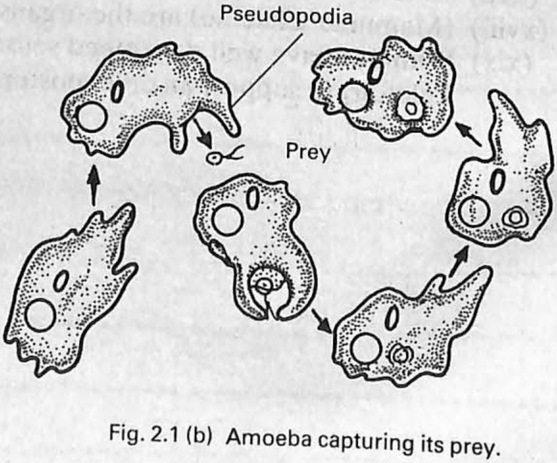


Fig. 2.1 (b) Amoeba capturing its prey.

thrown out of the cell.

The water from the surroundings can enter the amoeba through the membrane causing an excess of it. The **contractile vacuole** collects this excess water and throws if out of the cell. Amoeba takes in oxygen and gives out carbon dioxide through the surface of the body. It has a large, spherical nucleus which changes position according to the flow of the cytoplasm. It responds to the stimuli of temperature, touch, strong light, etc., by moving away from it. It shows a positive response to food by moving towards it and in unfavourable conditions becomes an inactive round mass.

Reproduction occurs when the amoeba reaches its maximum size. The mature cell divides, with the nucleus dividing first and moving to opposite ends. The protoplasm then separates into two masses each having a nucleus. This process is known as **binary fission**. Each of these two cells is capable of independent life and growth.

2.2 Hydra

Hydra is a very common fresh water coelenterate. It can be seen attached to the leaves of water plants in ponds and streams by means of a basal disc. Its cylindrical body which measures only a few mm is made up of a two-layered body wall. This wall consists of an outer layer called **ectoderm** and an inner layer called **endoderm.** A thin layer of structureless jelly called **mesogloea** separates these two layers. It is a simple multicellular form exhibiting distribution of functions between the different groups of tissues, i.e. it shows division of labour. The ectodermal cells are protective in nature and also serve as sense organs while the endodermal cells help in digestion.

The endoderm encloses a cavity, **coelenteron,** in which digestion of food takes place. A circular mouth is present on the anterior end, opposite the basal disc. The mouth is surrounded by a ring of six to ten movable, slender and tubular **tentacles.** The ectodermal layer of the tentacles and the body wall possess specialised cells called **nematoblasts.** These nematoblasts in turn have coiled stinging structures called **nematocysts.**

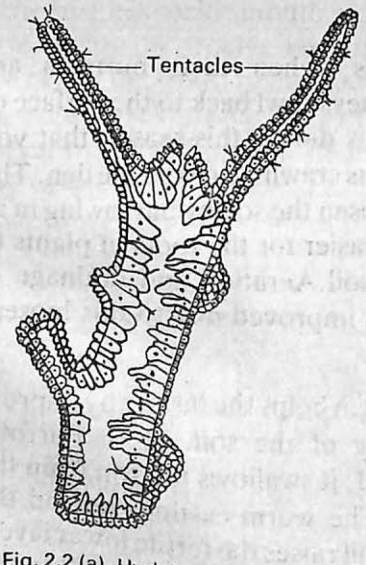


Fig. 2.2 (a) Hydra

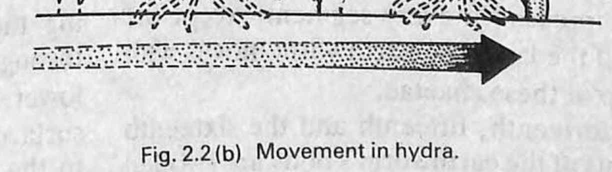


Fig. 2.2 (b) Movement in hydra.

The nematocysts may be discharged from the tentacles or the body wall to wrap around the prey on which the hydra wants to feed. Alternately they may sting the prey to inject some kind of poison which paralyses it. The tentacles then hold the captured prey and shorten. They generally curl towards the mouth and the latter opens and engulfs the prey. It may be noted here that the mouth only opens for a 'living' prey.

The hydra shows a queer form of movement. It stretches and bends so that the tentacles can touch the substance to which the hydra is attached, Fig. 2.2. The body then shortens and the hydra stands on its head. It again stretches its body and bends to get back to its original position and the tentacles are freed.

Hydra can reproduce by **budding**. A small projection like a bud comes out of the body and it develops tentacles and gets separated from the body of the adult to lead an independent life. It can also reproduce sexually. Both the sexes are present on the same individual i.e., it is a hermaphrodite.

2.3 Earthworm

Earthworms belong to the phylum Annelida and are found in pastures and marshes in any part of the world. They have a long, cylindrical body which is divided into rings or segments. It has a mouth at the anterior end and an opening at the posterior end, serving as the anus. The body has small bristle-like projections **chaetae,** which are hardened due to certain chemical depositions. Four pairs of bristles are present in every segment except the first and the last. The earthworm moves with the help of these chaetae.

The forteenth, fifteenth and the sixteenth segments of the earthworm's body are swollen and form the **clitellum**. This region has cells which secrete chemical substances. During mating, two earthworms come close and the secretions of the clitellum form an elastic girdle which binds the two together, Fig. 2.3. Both male and female reproductive organs are present in the earthworm, i.e., it is a hermaphrodite. The clitellum secretes the cocoon in which the worms lay the eggs.

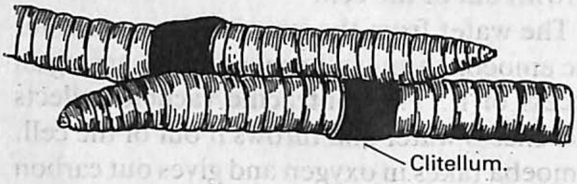


Fig. 2.3 Reproduction in earthworms.

Earthworms burrow into the humus enriched soil in which they live, by swallowing the soil. The humus part of the soil is digested by the earthworm and the remaining contents of the soil is given out as worm *castings*. During summer months when the upper layers of the soil become dry, the earthworm burrows deeper, down into the soil in search of moist layers.

In monsoons, when their burrows are water logged they crawl back to the surface of the soil and it is during this season that you find these worms crawling in your garden. The earthworms loosen the soil by burrowing in it. This makes it easier for the roots of plants to penetrate the soil. Aeration and drainage of water also gets improved due to this loosening.

The earthworm helps the farmer by improving the fertility of the soil. As it burrows through the soil, it swallows the soil from the lower layers. The worm castings left on the surface of the soil raises the fertile lower layers to the surface. The castings also contain the waste materials of the earthworm's body which contain compounds of nitrogen. It enriches the soil by increasing its nitrogen content.

2.4 Frog

The frog is the best known example of amphibians. They are found in abundance in tropical countries, in and around water. Water is essential because the frog breathes through its skin, and respiration can occur only across a moist membrane. The skin is thin and has glands which secrete mucous, to keep it moist and also slimy which makes it easy for the frog to slip away from a grip.

The frog's body is broad and angular. A pair of bulging eyes are situated on the head which allows the frog to look practically in all directions. Besides the upper and lower eye-lids there is a third one called a **nictitating membrane** which keeps the eye ball moist and protects it when the frog is in the water. Instead of external ears frogs have an eardrum called tympanic membrane behind and below each eye.

The frog has a wide mouth which allows it to move its tongue freely. The sticky tongue is attached at the front, to the floor of the mouth and folds back inside. When an insect is around the frog flicks out its tongue and the prey sticks to the sticky end. The tongue is then pulled into the mouth. The prey is digested and absorbed in the special areas meant for this purpose in the long alimentary canal.

Frogs have a pair of short, four-toed fore-limbs and a pair of long and webbed hind limbs. The strong hind limbs help the frogs to leap on land and swim in water. But all movements and activities are reduced during peak winters and summers. The animals bury themselves in mud or hide beneath rocks. The winter sleep is known as **hibernation** while the summer sleep is known as **aestivation**.

The female frog lays the eggs in water. The jelly-like covering of the eggs, swells up when in contact with water and protects the eggs and provides nourishment as well. Fertilization occurs in water and the eggs hatch out to form fish-like **tadpoles**. These are tiny creatures with a disc-like mouth, a pair of **external gills** for breathing and a tail to help them swim.

They may get attached to water-plants with the help of secretions from their bodies and feed on them. As the tadpole grows a fold of skin covers the external gills and converts them into **internal gills** It develops a long, coiled intestine and paired limbs appear as bud-like structures. A series of changes now occur to transform the fish-like herbivorous tadpole to a tail-less carnivorous frog. The tail of the tadpole shrinks, the gills disappear with the appearance of the lungs and the heart becomes three chambered and a baby frog hops onto the land. The structural and func-

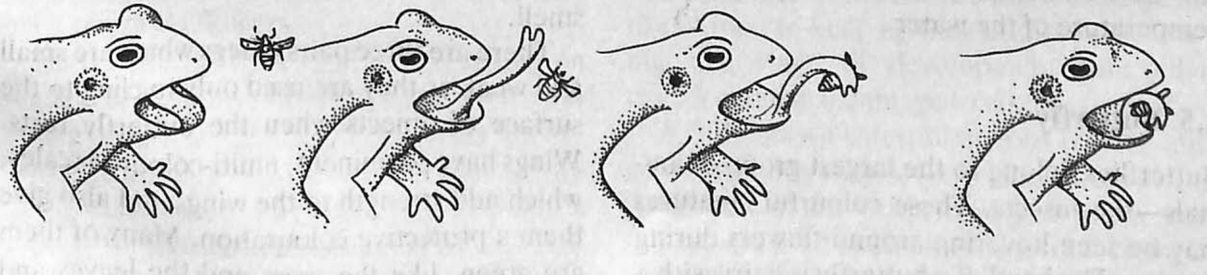


Fig. 2.4 The frog stalks its prey.

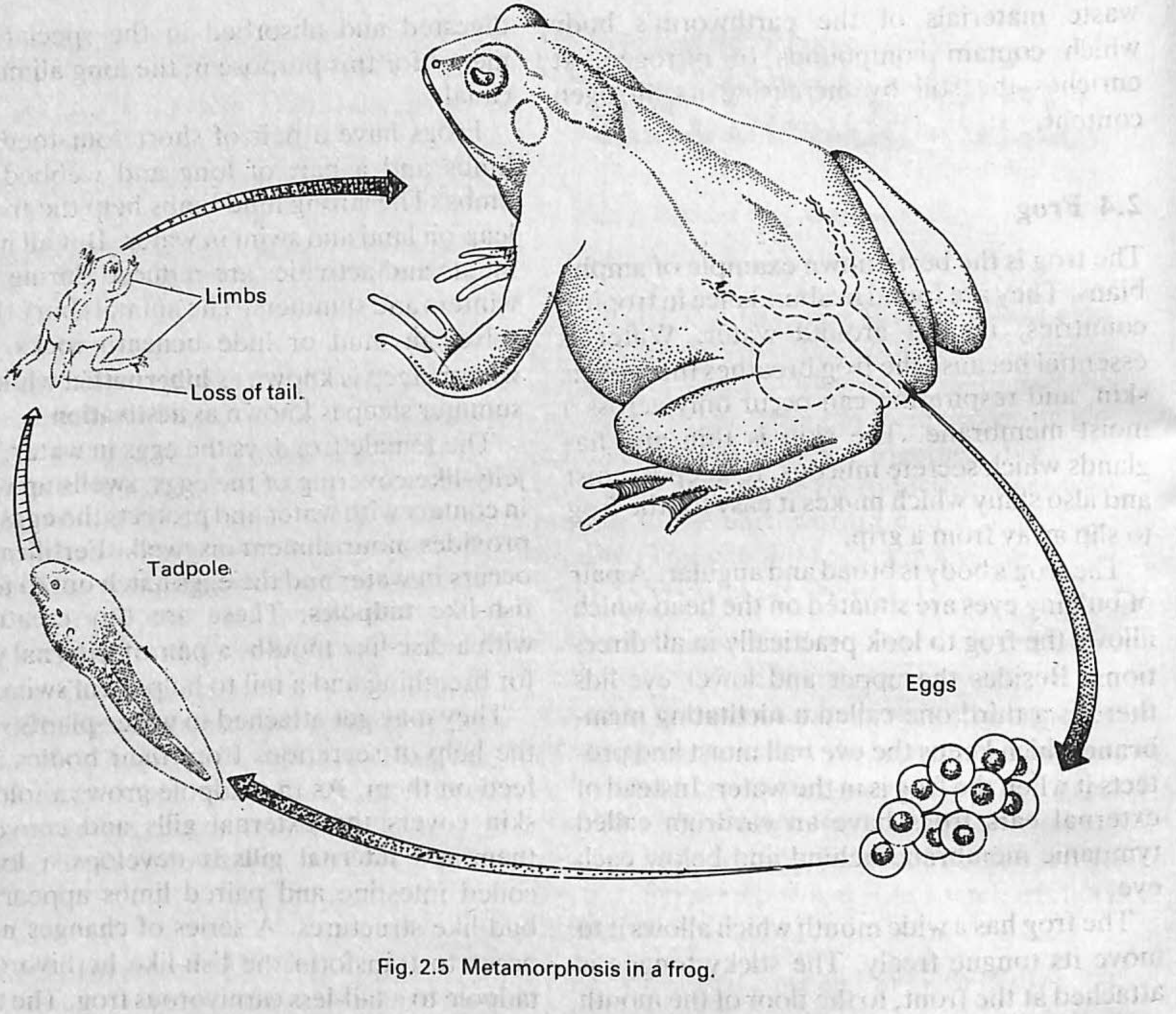


Fig. 2.5 Metamorphosis in a frog.

tional changes which transform a tadpole to a frog are together known as **metamorphosis**.

Metamorphosis on an average takes three months but this period may vary according to the environmental conditions especially the temperature of the water.

2.5 Butterfly

Butterflies belong to the largest group of animals—the insects. These colourful creatures may be seen hovering around flowers during the day. The head of a butterfly is hairy with a pair of large and rounded compound eyes. It has a long tube-like tongue or **probosis** which can reach up to the nectar glands of flowers and suck the nectar. The pair of **antennae** are club-shaped and also serve as the organs of smell.

There are three pairs of legs which are small and weak as they are used only to cling to the surface of objects when the butterfly rests. Wings have prominent, multi-coloured scales, which add strength to the wings and also give them a protective colouration. Many of them are green, like the grass and the leaves and

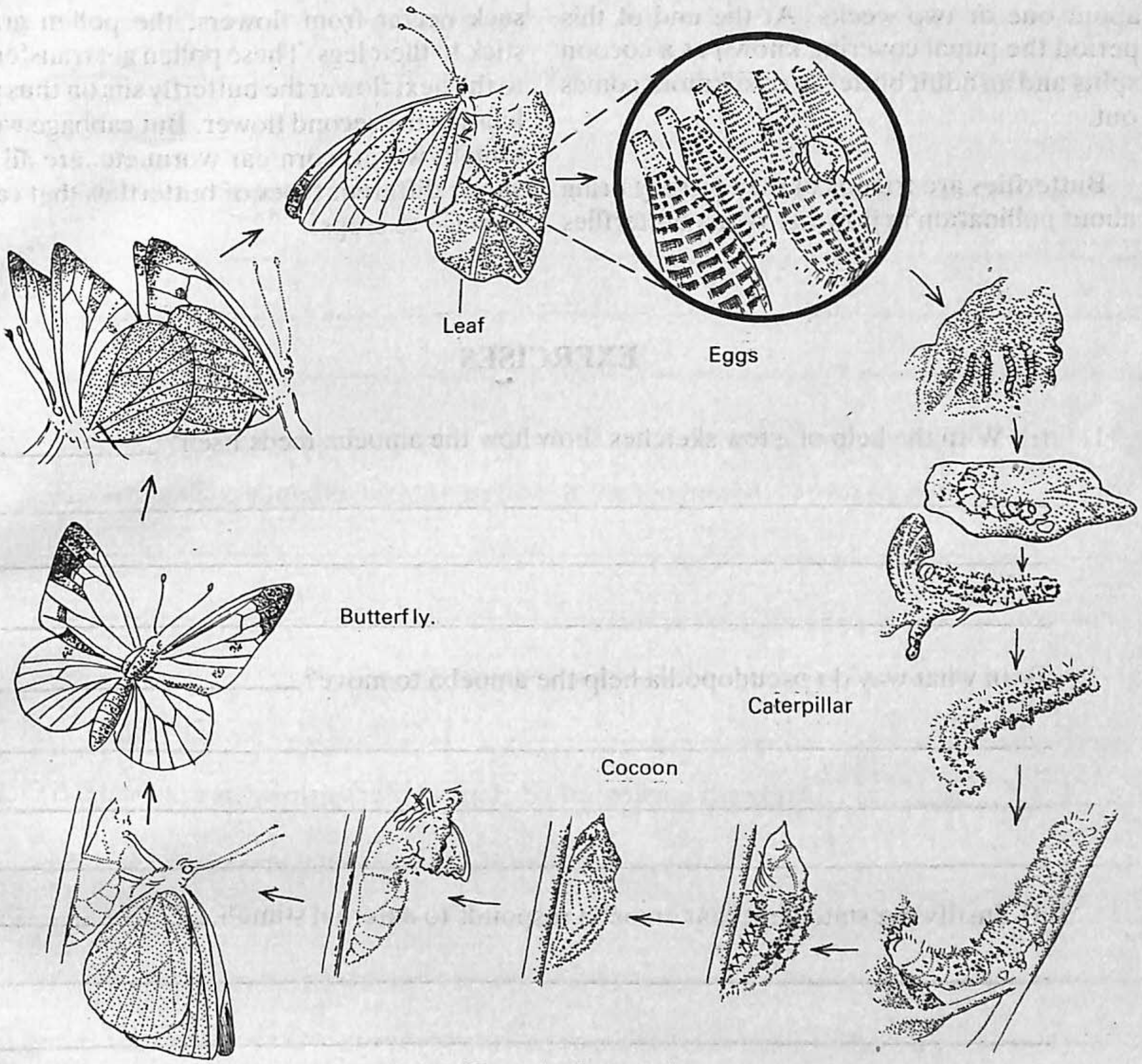


Fig. 2.6 Life-cycle of a butterfly.

some may be coloured like dry leaves or may even resemble flowers.

Butterflies lay their eggs during spring on the leaves or stems which serve as food for the young ones. The eggs hatch out during the following summer. The young one that comes out does not in any way look like the adults. It is a worm-like **caterpillar** or **larva**. It feeds voraciously on leaves of plants where the eggs had been laid. It has to consume a large quantity of food to keep up the rapid growth. During this stage of development caterpillar causes extensive damage to crops.

A fully grown caterpillar stops feeding and covers its body with twigs or threads of silk (as in the case of silk worm) and goes into a resting stage called **pupa stage**. Internal changes take place during this period which lasts for about one or two weeks. At the end of this period the pupal covering known as a cocoon splits and an adult butterfly or silkmoth comes out.

Butterflies are friends of man as they bring about pollination in flowers. While butterflies suck nectar from flowers, the pollen grains stick to their legs. These pollen get transferred to the next flower the butterfly sits on thus pollinating the second flower. But cabbage worm tomato worm, corn-ear worm,etc.,are all larvae of different types of butterflies that cause damage to crops.

EXERCISES

1. (i) With the help of a few sketches show how the amoeba feeds itself?

(ii) In what way do pseudopodia help the amoeba to move?

(iii) Justify the statement that amoeba responds to external stimuli.

2. (i) Explain how hydra exhibits division of labour.

(ii) How are nematocysts useful to hydra?

(iii) Give a diagrammatic representation of the movement shown by hydra.

3. (i) How do earthworms help farmers by burrowing the soil?

(ii) How do worm castings enrich the soil?

4. (i) Write an account of how the frog's body is modified to suit its ways of living.

(ii) Does a tadpole differ from an adult frog? Give reasons to support your answer.

5. (i) Why do frogs have to seek shelter from extreme climate?

6. (i) The way in which the butterfly protects itself from its enemies:

(ii) Caterpillars cause extensive damage to our crops. How? ______________________

____

____

____

____

____

(iii) How do butterflies help to pollinate flowers? ______________________

____

____

____

____

____

7. (i) Match the following:

(i) Amoeba reproduces by	(a) is called mesoglea.
(ii) The process of excretion in amoeba	(b) known as nictitating membrane.
(iii) Ectodermal cells in hydra	(c) binary fission.
(iv) The structureless jelly-like layer of cells in hydra	(d) aestivation.
(v) Earthworms reproduce with	(e) is performed by the contractile vacuole.
(vi) Frogs have a third eye-lid	(f) the help of clitellum.
(vii) The summer sleep of frogs is known as	(g) to suck nectar of flowers.
(viii) Butterflies have a tube called probosis	(h) are protective in function.

3

Food and Digestion

Our body is an intricate machine which performs many diverse activities. Just like all other machines our body too requires fuel for its proper functioning. The food that we eat is the fuel which keeps our body going. The food is broken down in the cells in the presence of oxygen, to release energy. When the cells oxidise the food certain wastes are formed. These wastes have to be removed. So the cells carry out the various functions of breaking down food into smaller particles and utilising the energy released for vital processes. The new materials are used for the growth and repair of tissues. *The process of absorption of the simpler molecules of food by the cells and the utilisation of the same for the maintenance of the health of the body* is known as **assimilation**. All these functions are chemical in nature and are collectively known as **metabolism**.

The food that we eat consists of large complex molecules of protein, carbohydrate, fat etc. This food has to be converted into smaller molecules that can dissolve in water and can pass through the cell membrane into the cytoplasm. This *conversion of complex food molecules into simpler absorbable ones with the help of chemicals known as enzymes, and their absorption by the body* is known as **digestion**.

In unicellular organisms such as amoeba and paramecium the process of digestion takes place in the **food vacuole**, a fluid-filled cavity within the cytoplasm. This type of digestion is known as **intracellular digestion** whereas in animals, including man and other mammals, digestion takes place in the specialised digestive tract called the **alimentary canal** and is known as **extracellular digestion**. Certain intestinal parasites like tape worms have no digestive system. The digested food which is present in the intestinal contents of the host, simply diffuse into the body of the tape worms. All other animals have tubular digestive tract starting from the mouth and ending up in a posterior opening **anus**, through which food residues or **faeces** are given out.

3.1 Digestive System in Man

All the organs that help in the digestion of food constitute the **digestive system.** The pro-

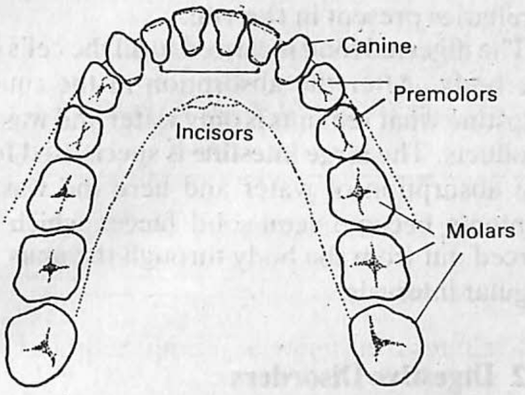


Fig. 3.1 Kinds of teeth in man.

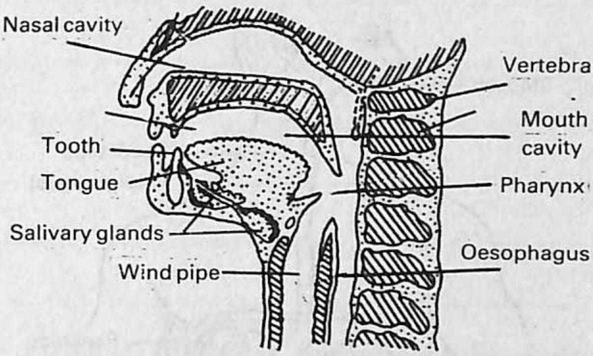


Fig. 3.2 Food mixed with saliva passes from mouth to oesophagus.

cess of digestion begins in the mouth. Here the food is chopped and crushed with the help of the different types of teeth present in the mouth,as in Fig. 3.1. The chemical action of the enzymes is accelerated if the food is broken down into smaller particles. The tongue, the cheek muscles and the lower jaw then roll the food particles around in the mouth and mix them with the **saliva** secreted by the **salivary glands**. Saliva has a digestive juice called **ptyalin** which helps in the conversion of starch to maltose. **Taste buds** present on the surface of the tongue can detect four taste sensations i.e.,sweet, sour, salty and bitter.

From the mouth, the chewed food is passed on to a thick-walled tubular organ known as the **oesophagus** which is lined by **mucous** secreting cells, Fig. 3.2. Mucous is a slimy substance which provides a slippery surface and helps in the movement of food along the digestive tract. The food is moved along by the muscle action called **peristalsis** which is caused due to the alternate contraction and relaxation of two sets of muscles, the **inner circular** and **outer longitudinal.**

The oesophagus opens towards the **stomach** which lies in the abdominal cavity. The muscle action of the stomach mixes the food particles with the **gastric juices** secreted by the **gastric glands.** These juices contain hydrochloric acid, **pepsin**, **lipase** and **rennin**. Pepsin helps in the break-down of proteins into smaller components called **amino acids**. Hydrochloric acid destroys the germs which may be present in the food and dissolves mineral substances. Lipase helps in the conversion of fats to **fatty acid** and **glycerol.** Rennin changes milk to curd. By this time, the food is in the form of a liquid and is called **chyme**.

From the stomach the partly digested food is given out in small amounts into the first part of the small intestine—the **duodenum**. The duodenum receives secretions from the digestive glands **liver** and **pancreas**. The liver is situated on the right side of the stomach and the pancreas, under the stomach, Fig. 3.3. The liver produces the **bile** juice which is stored in the **gall bladder**. The bile comes to the intestine by a tube called the **bile duct**. The pancreas produces the **pancreatic juice** which contains enzymes **trypsin**, **amylase** and **lipase**. Trypsin converts undigested proteins to amino acids. Amylase acts on starch and breaks it down to simpler sugars such as **glucose**. Lipase converts fats to fatty acid and glycerol. The digestion of fat is assisted by bile juice as well. The intestinal wall also secretes

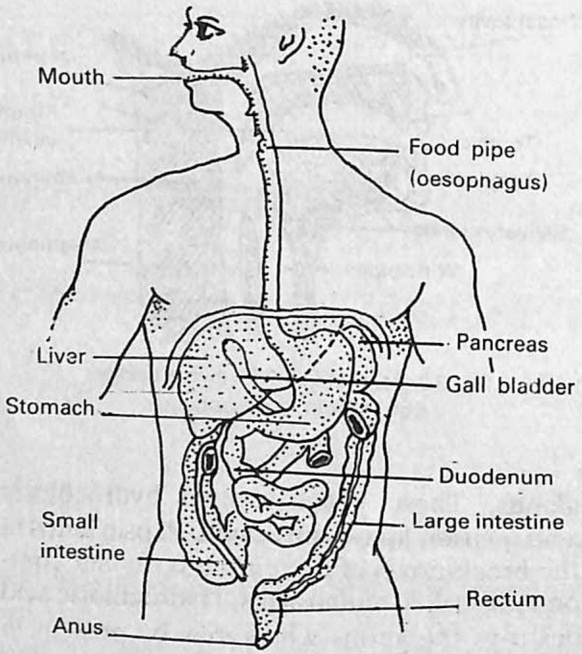


Fig. 3.3 Digestive organs in man.

certain juices which help in the digestion of carbohydrates and proteins.

Thus digestion is completed in the small intestine. All the end products of digestion are absorbed by the blood vessels present in the wall of the small intestine. The inner wall of the small intestine has numerous microscopic finger-like projections called **villi**. Villi show a constant, back and forth swinging motion. They increase the area of absorption. Fat products are absorbed by the **lymph vessels** which are a part of the blood vascular system in the villi, while sugars and amino acids enter blood capillaries present in the villi.

The digested food is carried to all the cells of the body. After the absorption in the small intestine what remains is only water and waste products. The **large intestine** is specialised for the absorption of water and here the waste contents become semi-solid faeces which is forced out from the body through the **anus** at regular intervals.

3.2 Digestive Disorders

When a person's digestive system is normal, the digestive process goes on day-in and day-out without any problem. But the slightest malfunctioning of any part of the alimentary canal causes digestive disorders. Too much of spicy and fatty food can disturb the functioning of the alimentary canal, as it has to do more work in order to digest such food. This can result in stomach ache. Another common ailment of this system is **constipation**, i.e. when the large intestine fails to discharge its contents regularly. This may be due to excess of gas in the large intestine or lack of peristaltic movements or lack of water in the intestine. On the other hand **diarrhoea** is caused when the large intestine eliminates the wastes without absorbing the water. Such elimination occurs very frequently due to the overactivity of the large intestine.

For the proper functioning of this system it is essential to ensure regular bowel movements, have a balanced diet and prompt medical attention in case of any complaint.

EXERCISES

1. Why should we take food? ______________________________
____

2. What is the need for digestion?

3. Differentiate between intracellular and extracellular digestion, giving examples of the two types.

4. Name the digestive organs in man.

5. Give the role of the following in digestion.

   (a) Oesophagus

   (b) Gastric glands

(c) Stomach ____

____

____

____

(d) Small intestine ____

____

____

____

(e) Villi ____

____

____

____

(f) Large intestine ____

____

____

____

6. Draw a labelled diagram of the alimentary canal in man.

7. List the function of the following digestive juices.

(a) Saliva ____

____

(b) Pepsin ____

____

(c) Lipase ____

____

(d) Bile ____

____

(e) Hydrochloric acid ____

____

(f) Amylase ____

____

8. Write in short the process of digestion in man. ____

____

____

____

____

____

9. Fill in the blanks.
   (a) In amoeba and paramecium the process of digestion takes place in ____________.
   (b) In man and other mammals digestion takes place in the specialised digestive tract called the ____________.
   (c) ____________ present on the surface of the tongue help in detecting taste of food. The four taste sensations are ____________, ____________, ____________ and ____________.
   (d) ____________ is a slimy substance which provides a slippery surface and helps in the ____________ of food along the digestive tract.
   (e) The food is moved along by the muscle action called ____________.
   (f) ____________ helps in converting milk to ____________.
   (g) The first part of the small intestine is known as the ____________. It receives secretions from the digestive glands, ____________ and ____________.
   (h) The waste contents are thrown out of the body through the ____________ at regular intervals in the form of ____________.

(i) ______________ is caused when the large intestine eliminates the wastes without absorbing the water.

(j) Lack of water in the ______________ ______________ causes ______________.

4

Respiration

Man can live without food for weeks. He can live for many days without water. But he cannot exist without air for even a few minutes. Oxygen is necessary for all body activities without which the brain cells would fail to function, the heart would stop beating, muscles would not contract and so on, i.e., life would come to a standstill. The process of taking air into the body is called **inspiration** or **inhaling**. The giving out of air (containing carbon dioxide discharged from the body) is called **expiration** or **exhaling**.

The *exchange of gases that takes place between the living body and the environment* is called **breathing.** However, the term **respiration** is used for those *reactions that take place inside the cells, in which the food molecules are broken down to release energy*. When this takes place in the *presence* of oxygen it is known as **aerobic** respiration and when it occurs in the *absence* of oxygen it is called **anaerobic** respiration. Living organisms utilise the energy thus released for sustaining their various life activities. Respiration is a process common to all living beings.

4.1 Respiration in Different Organisms

Unicellular animals and many other smaller animals like sponges, jelly fish, etc., do not have any special organ for respiration. If the size of the animal is small and the body surface is permeable to oxygen and carbon dioxide, respiratory exchange takes place by means of diffusion. That is, oxygen and carbon dioxide molecules permeate living cell membranes readily because such membranes are thin and moist. However, they cannot diffuse through dry membranes. If the cells are in direct contact with the atmospheric air or if they are surrounded by water, an exchange of gases takes place directly between the cells and the surroundings.

Plant cells also respire in this way. Fresh water and marine organisms such as hydra and planarians also do not have any specialised organs for respiration. Diffusion of gases takes place through the cells of the body to and from, the surrounding water. In hydra oxygen also diffuses from the water present in the digestive cavity. Earthworms respire with the help of their moist skin. Since diffusion is a very slow process and the body of the earthworm is long, oxygen is transported to the internal cells through the blood in the circulatory system. Blood carries oxygen to the cells and transports carbon dioxide towards the skin.

Grasshoppers and other insects have ten pairs of openings on the sides of their body known as **spiracles**. These openings lead to the **tracheal** tube which branches repeatedly. The inner end of this tube contains a fluid. Oxygen dissolves in this fluid and then diffuses into the cells. Carbon dioxide moves out in the opposite direction. In this type of respiratory system, blood is not required for carrying oxygen and carbon dioxide. Such a system however, may not be sufficient to fulfil the needs of large animals. When the structure becomes more complicated the cells may not be able to obtain direct contact with the environment and special respiratory organs are required. All these are examples of aerobic respiration.

Tape worms and round worms show anaerobic respiration as they are parasites present in the alimentary canal of man.

In a fish, the **gills** are the organs of respiration. Fishes expose the gills to water by taking

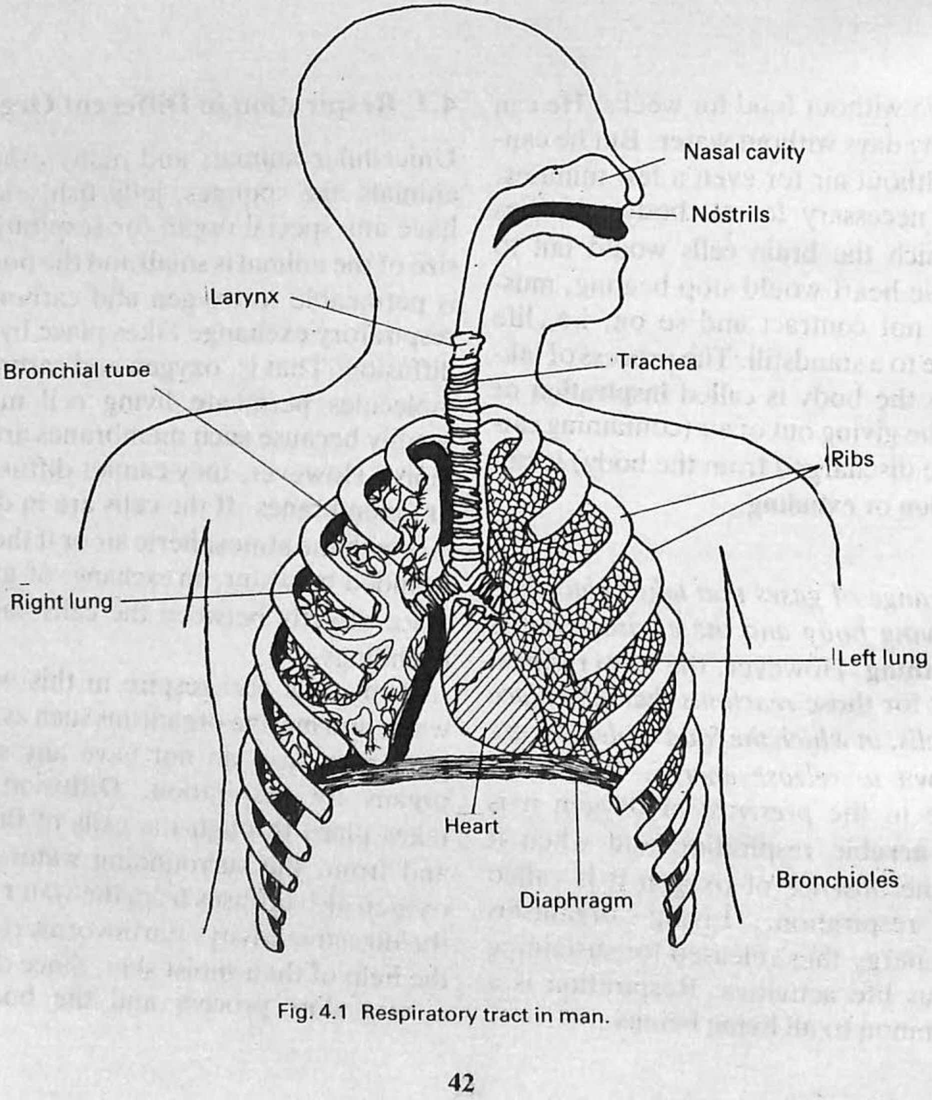


Fig. 4.1 Respiratory tract in man.

water through the mouth. The filaments of the gills contain numerous blood capillaries. These capillaries facilitate the exchange of oxygen (from the water) and carbon dioxide (from the body of the fish).

Frogs can respire with the help of their moist skin. They also have a pair of **lungs** for the same purpose. Lungs are simple sac-like structures with an abundant supply of blood vessels . The lungs of frogs do not possess muscles and the pumping of air is carried out by the squeezing of the muscles of the body. Reptiles also have a similar type of lungs but with a large number of folds on the inner surface. In birds, the respiratory capacity is greatly increased by a system of sacs which extend from the lungs.

4.2 Respiration in Mammals

In man and other mammals, the air enters the body through the nose. The nose opens outwards through a pair of openings called **nostrils**. At the entrance of the nostrils, there are hairs, **cilia**, that prevent dust particles from entering the lungs. The lining of the nose is made of a moist mucous membrane and possesses ciliated cells which assist in removing dust particles and other harmful foreign material. This membrane makes the inhaled air moist and warm before it enters the lungs, Fig. 4.1.

The nasal cavity continues into the tubular **pharynx**. From there, the air passes into a chamber called **larynx** or voice-box. There are two chords in the larynx known as the **vocal chords** which vibrate to produce sounds. The opening of the pharynx into the larynx is guarded by the **epiglottis**, which is a muscular flap. The pharynx is a common passage for both food and air, so the epiglottis closes the opening when we swallow food. However, it remains open for breathing. The larynx leads

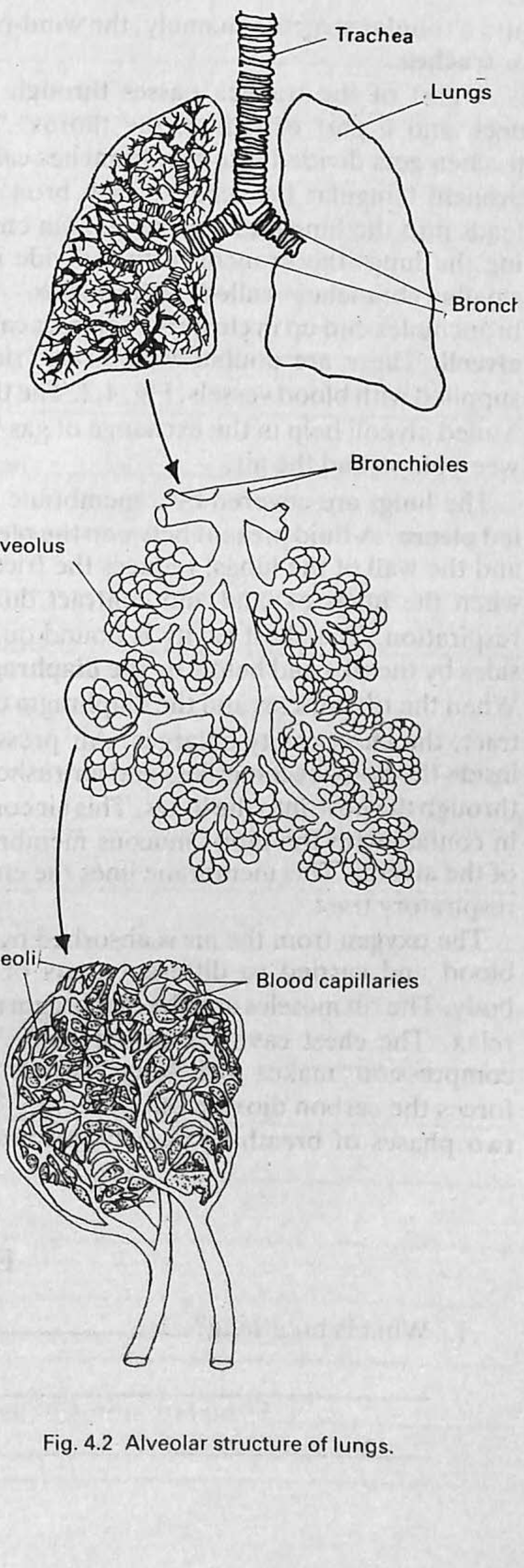


Fig. 4.2 Alveolar structure of lungs.

into a tubular structure namely, the wind-pipe or **trachea**.

A part of the trachea passes through the neck and a part of it is in the thorax. The trachea gets divided into two branches called **bronchi** (singular bronchus). Each bronchus leads into the lung on its own side. On entering the lungs the bronchi further divide into smaller branches called **bronchioles**. The bronchioles end up in clusters of air sacs called **alveoli**. These are double-walled sacs, richly supplied with blood vessels, Fig. 4.2. The thin-valled alveoli help in the exchange of gas between blood and the air.

The lungs are covered by a membrane called **pleura**. A fluid present between the pleura and the wall of the lungs, reduces the friction when the lungs expand and contract during respiration. The chest cavity is bound on the sides by the ribs and below by the **diaphragm**. When the rib muscles and the diaphragm contract, the chest cavity enlarges. Air pressure inside the body becomes less and air rushes in through the nose into the lungs. This air comes in contact with the moist mucous membrane of the alveoli. This membrane lines the entire respiratory tract.

The oxygen from the air is absorbed by the blood and carried to different parts of the body. The rib muscles and the diaphragm then relax. The chest cavity is compressed. This compression makes the lungs shrink and forces the carbon dioxide out of them. These two phases of breathing namely, inspiration and expiration, are repeated about eighteen times per minute.

4.3 Respiratory Disorders

We are always surrounded by air. This air may contain disease causing germs. Though the ciliated lining of our respiratory tract filters out dust and germs from the air we breathe in (before it enters the lungs) some germs may enter our system. As a result, we may be afflicted by certain ailments, e.g., small-pox, chicken-pox, measles and all other viral infections. Cold, cough, bronchitis, pneumonia and diphtheria are some diseases of the respiratory tract. Certain allergy symptoms particularly **asthma**, affect the respiratory system. Abnormality of alveolar structure and function is another common respiratory disease which leads to a hereditary disease, **cystis fibriosis**. Respiratory disorders generally cause breathing problem.

Excessive smoking also causes irritation of the throat and the respiratory passages leading to severe coughing and other complications. Cigarettes, bidis and cigars necessarily contain tobacco which in turn contains a chemical called **nicotine**. This nicotine has harmful effects on the nervous system, the blood vessels and the lungs. Prolonged smoking impairs the effective functioning of these organs. Heavy smoking is also known to cause cancer of the lungs.

EXERCISES

1. What is breathing? ______________________________

2. What is the difference between inspiration and expiration?

3. Differentiate between breathing and respiration.

4. Respiratory organs in man are:

5. What is the function of epiglottis?

6. What are alveoli?

7. Write how the air entering the lungs is made free of germs and dust?

8. What do you mean by aerobic and anaerobic respiration. Give examples. ________

9. Fill in the blanks:
   (a) In lower organisms living in water, exchange of gases takes place by the process of ________.
   (b) Frogs respire with the help of their ________ and ________.
   (c) During breathing, ________ from the air is inhaled and ________ from the body is given out.
   (d) Openings on the sides of the body of insects which help in respiration are known as ________.

10. Match the following:

A	B
(a) Larynx	(1) membrane covering the lungs.
(b) Alveoli	(2) organs of respiration in fishes.
(c) Pleura	(3) voice-box.
(d) Gills	(4) chemical substance present in tobacco.
(e) Nicotine	(5) clusters of airsacs.

5

The Circulatory System

Our body performs various activities for which we require energy. In order to obtain this energy each and every cell of the body must be provided with food as well as oxygen. So we need a transport system which would carry (i) the digested materials from the intestine to the different organs (ii) the waste materials from the organs to those from which they are to be thrown out (iii) oxygen from the lungs to all the tissues and (iv) also collect carbon dioxide from the cells and transport it to the lungs.

The fluid which carries all these substances to and fro is called **blood**. In the human body, blood runs through *an intricate network of tubular vessels*, forming the **circulatory system** *which performs the transport function*. Thus, blood and the circulatory system are together responsible for carrying materials from one part of the body to another. Let us now study more about this important fluid blood.

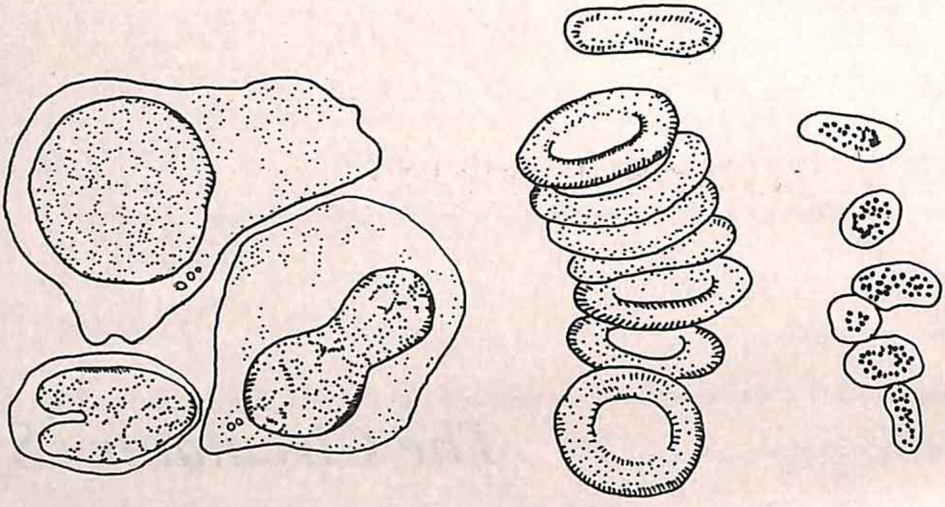
5.1 Composition of Blood

Plasma

Blood is composed of a number of cells floating in a liquid component called **plasma**. Plasma is a clear, pale yellow liquid and provides a suitable medium for the blood cells or **blood corpuscles**, as they are called. There are two types of blood corpuscles, **red** or **white**, about which you will study in the following sections. About nine-tenth of plasma is water. The remaining one-tenth contains dissolved food, mineral salts, waste materials, hormones (secretions of the endocrine glands) and certain proteins known as **fibrinogen** and **globulin**. Food is transported *to all the cells of the body* and *waste matter away from all the cells* by the plasma of the blood.

Red Blood Corpuscles

These are biconcave, disc-like cells without nucleus (unlike other cells), Fig. 5.1. Every drop of blood contains millions of these cells. These **red blood corpuscles** (R.B.C) are responsible for carrying oxygen to the various body tissues. They transport oxygen with the help of an iron-rich pigment called **haemoglobin**. On leaving the lungs, the blood is bright red in colour as the R.B.C.s are carrying oxygenated blood. As the blood moves



(a) Red blood corpuscles (b) White blood corpuscles (c) Platelets

Fig. 5.1 Composition of blood

through the body, it gradually loses the red colour and becomes purplish or bluish red. This is because the blood has given out its oxygen to the tissues and has taken up carbon dioxide from them. R.B.Cs are produced in the red bone marrow of ribs, the vertebrae, the sternum and the long bones.

White Blood Corpuscles

These are large, irregular and colourless cells in the plasma, Fig. 5.1. Their number is much lesser than the R.B.Cs. The **white blood corpuscles** (W.B.C) have a nucleus unlike the R.B.Cs. They can pass through most of the blood vessels by squeezing out of the intercellular spaces in the walls of the blood vessels. Their chief function is to gather at the site of an injury or infection and destroy the infection-causing germs (**microbes**) by engulfing them. The W.B.Cs sometimes produce chemical substances called **antibodies** which act upon the more dangerous types of germs and help to destroy them. The antibodies also neutralise the effect of the poisonous substances (**toxins**) produced by the microbes.

Blood Platelets

These are very small, irregular bodies, lacking a nucleus, as shown in Fig. 5.1. They are fragments of protoplasm broken or separated in some way from gaint cells found in the red bone marrow. They play an important role in the **clotting** of blood by producing an enzyme **thrombin** with the help of a plasma protein **prothrombin**. Thus, loss of blood during an injury or operation is prevented by its clotting or **coagulation**. Blood does not clot during its flow in the body due to the *absence* of thrombin, which can however, be rapidly formed whenever required due to the presence of prothrombin in the plasma.

5.2 Functions of Blood

In addition to transporting food materials and oxygen to the various tissues of the body and conducting the waste materials from the cells to the organs from where they are given out to the exterior, blood performs a few other functions as well. They are as follows:

1. Blood maintains the water content of the tissues. Although blood itself is contained in closed vessels a constant interchange of the fluid occurs across the walls of the blood vessels.

2. Blood helps to maintain a constant body temperature. For our body tissues to perform the various metabolic functions, a fixed temperature is required. When we work continuously for some time, it results in excessive oxidation of food. A lot of heat is generated which is harmful to the body. So the blood distributes this excess heat equally throughout the body.

3. Blood protects the body from the invasion of bacteria, viruses and other disease-causing germs with the help of W.B.Cs and antibodies which are specific in action. A particular antibody is produced to destroy a particular germ. Some of us are born with the ability to resist diseases. This is called **natural immunity**. When we develop resistance to a disease, by retaining adequate levels of antibodies produced during our previous illness, it is known as **acquired immunity**. We may acquire immunity by taking an injection of a mild dose of disease-causing germ in the form of a **vaccine**. The body is made to produce its own antibodies against the injected microbe.

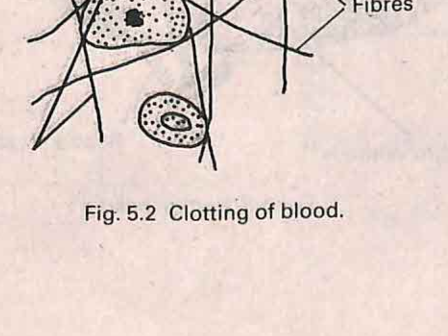


Fig. 5.2 Clotting of blood.

4. Another function of blood is coagulation or clotting. Blood flows from a wound, but after sometime the flow stops due to its thickening. As you have read earlier the platelets produce an enzyme thrombin, which acts on the protein fibrinogen forming an insoluble substance, **fibrin**. The fibres of fibrin form a network in which the blood corpuscles get entangled and prevent further loss of blood, Fig. 5.2.

Some individuals lack the plasma protein required for clotting. Such persons suffer from a disease called **haemophilia** and they bleed excessively even from a small cut. In case of profuse bleeding, individuals may be given a donation of blood (**transfusion**). But transfusion of blood cannot be given randomly from any person. Blood is divided into groups, **A**, **B**, **AB** and **O**, depending on certain substances (**antigens** and **antibodies**) present in it. Now, we are fully able to appreciate the importance of blood. Let us now study the circulation of blood through the vessels.

5.3 Circulation of Blood in Various Organisms

You have already read how food has to be circulated to the different parts of the body for its sustenance. In unicellular organisms such as amoeba and other simple organisms such as hydra, the transport of food materials is done by diffusion. But since it takes a very long time for solid molecules to diffuse even a few inches, higher organisms with large bodies require an additional means of transporting the essential materials.

Grasshoppers and other insects such as cockroaches and houseflies have an **open cir-**

culatory system. Here the blood does not flow through closed vessels, but instead does so through the large spaces in the body and bathes the tissues. They have a small heart at the upper part of the body to help in the exchange of gases.

In segmented worms such as the earthworms, etc., transport of materials takes place with the help of a **closed circulatory system**. The basic structure of this system is very much similar to that of man and other complex animals. In such organisms the blood flows through closed tubes, i.e., the **blood vessels**, which are present in every part of the body.

In vertebrates the blood is carried to different parts of the body by a full-fledged circulatory system. This system consists of the **heart** which pumps blood and a network of blood vessels called **arteries**, **veins** and **capillaries**, which actually transport the blood. The walls of the arteries are tough and elastic so as to withstand the force of the blood pumped out by the heart. In the fish, this organ is two-chambered and becomes more complex in toads, lizards and mammals.

The arteries carry oxygenated blood away from the heart while the veins take the impure deoxygenated blood back to the heart. The pressure exerted by the blood is quite reduced by the time it reaches the veins. So to prevent the backflow of this slow moving blood, **valves** are present in the veins of mammals. These valves allow the blood to flow in one direction only, i.e., towards the heart.

5.4 Blood circulation in Mammals

The blood is pumped to the different organs of the body by the heart. In mammals, the heart is four-chambered and there is complete separation of oxygenated and deoxygenated blood. In human beings, the heart is a muscular organ of the size of one's fist. It lies towards the left of the chest. The heart is completely enclosed and protected by a double-walled membrane called the **pericardium**. Between the heart and the pericardium a fluid is present to reduce friction.

The heart is divided into two halves, the right half and the left half, which are separated by a muscular wall called the **septum**. Each half has two chambers—the upper thin walled chambers called **auricles** and the lower thick and muscular chambers called **ventricles**. Oxygenated blood from the lungs is collected in the left auricle. When this auricle contracts, it pushes the blood into the left ventricle, through the connecting valve. Here again the blood can flow only from the auricles to the ventricles and not in the opposite direction.

Contraction of the left ventricle pushes the blood out through the main artery, the **aorta**, Fig. 5.3. The aorta divides into smaller arteries which further divide into capillaries. These capillaries are capable of exchanging

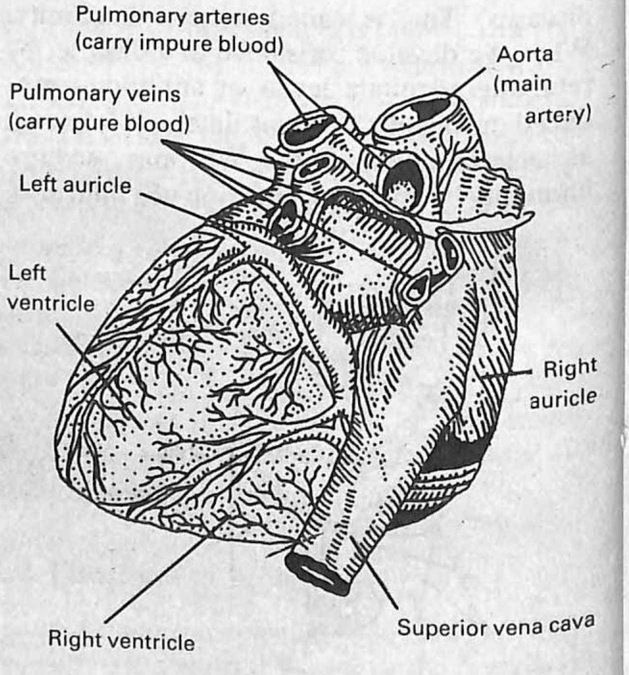


Fig. 5.3 Human heart

food, oxygen and waste materials with tissues of the organs in which they are present. The blood thus becomes deoxygenated. This blood from the capillaries now gets passed on to the veins. Two large veins—**superior vena cava** and **inferior vena cava** return this impure blood to the right auricle of the heart.

The blood then goes to the right ventricle from where it is pumped out through the **pulmonary artery** to the lungs. Here the blood receives oxygen and becomes oxygenated and is brought to the left auricle by the **pulmonary vein**. This cycle is repeated, as shown in Fig. 5.4. It must be noted that the pulmonary artery and the pulmonary vein are the only exceptions in that they carry deoxygenated and oxygenated blood respectively. The heart muscles have their own blood supply carried through the **coranary artery**.

The heart of a human being at rest beats about 72 times per minute. With each heart beat a pulse or wave spreads through the arteries. This is caused due to the impact of blood pressure on the walls of the arteries and

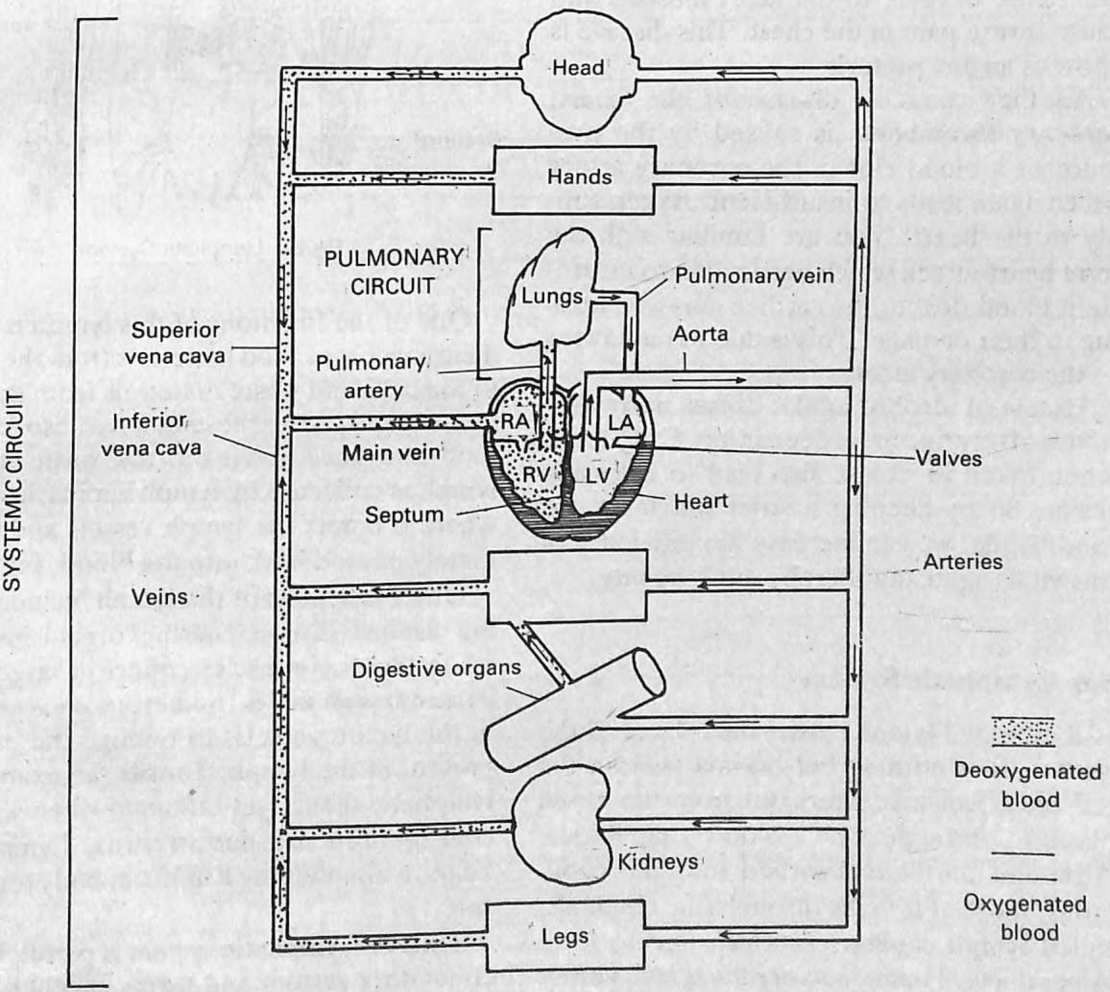


Fig. 5.4 Circulatory system of man

can be felt by placing a finger on the artery at the wrist. The pulse has the same rhythm as the heart beat.

5.5 Disorders of the Heart

Various types of disorders affect the heart. Heart diseases claim more lives annually as compared to other diseases. Sometimes the coronary artery may become narrow due to the deposition of calcium along the walls. This may completely block the passage of blood and hence oxygen, to the heart muscles and cause severe pain in the chest. This disease is know as **angina pectoris**.

Another common disease of the heart, **coronary thrombosis**, is caused by the presence of a blood clot in the coronary artery which again leads to insufficient oxygen supply to the heart. You are familiar with the term heart-attack which occurs due to insufficient blood flow to the cardiac muscles, leading to their damage. This is due to narrowing of the coronary artery.

Excess of alcohol intake causes narrowing of this artery due to fat deposition. Fatty foods when taken in excess also lead to the same result. So by keeping a strict watch on our food habits, we can increase the efficiency of this vital organ and thereby our longivity.

5.6 Lymphatic System

A fluid called **lymph** bathes the cells of all the tissues. It is nothing but plasma *without* the red blood cells. It filters out from the blood plasma through the blood capillaries. Although partly reabsorbed into the capillaries, most of it flows through fine channels, called **lymph capillaries**, which join to form larger ducts. These ducts are the **lymph vessels** forming the **lymphatic system**.

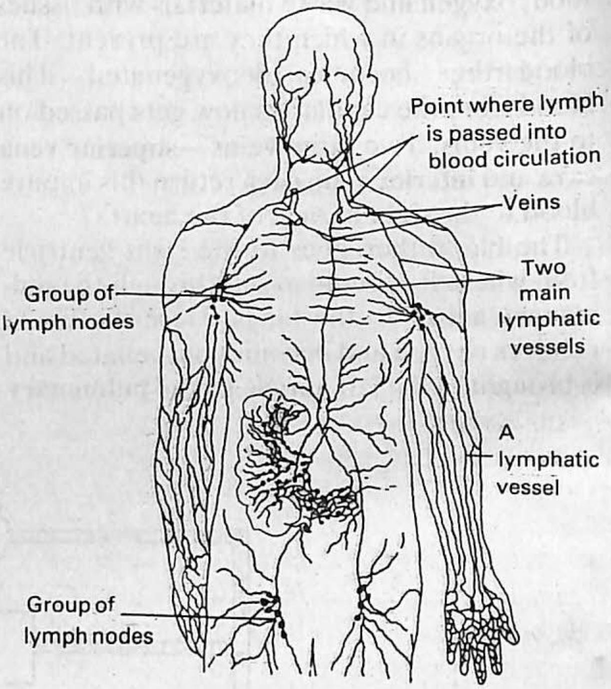

Point where lymph is passed into blood circulation
Veins
Two main lymphatic vessels
Group of lymph nodes
A lymphatic vessel
Group of lymph nodes

Fig. 5.5 Lymphatic System

One of the functions of this lymph is to aid the transport of food materials from the blood to the cells and waste materials from the cells to the blood. After the cells have absorbed the food and have given out the waste matter, lymph is collected by lymph capillaries, from where it enters the lymph vessels and is ultimately poured back into the blood, Fig. 5.5.

Other functions of the lymph include fighting against disease-causing organisms. The white blood corpuscles collect in large numbers in **lymph nodes** (numerous enlargements in the lymph vessels) to remove the bacteria present in the lymph. **Tonsils**, an example of lymphatic tissue, get inflamed when we have cold or influenza due to virus. Lymph also helps in maintaining a uniform body temperature.

Thus the lymphatic system is parallel to the circulatory system and forms another link in the system of transport in the human body.

EXERCISES

1. Name the transport system of the human body and give its functions.

2. Write in brief about the various constituents of blood.

3. What is the role of platelets in the clotting of blood?

4. Give the functions of blood in brief.

5. Explain with examples the difference between open and closed circulatory systems. ________

6. Why can you feel the pulse in an artery and not in a vein? ________

7. Draw a schematic sketch of the circulation of blood in man. ________

8. Fill in the blanks:
   (a) The iron-rich pigment responsible for the transport of oxygen is called________.
   (b) ________ blood leaving the lungs is bright red in colour but ________ blood has a purplish colour.
   (c) W.B.Cs with the help of ________ destroy microbes by neutralising the ________ produced by them.
   (d) An individual is said to possess ________ ________ if he is born with the ability to resist diseases.
   (e) ________ is the power of resistance to diseases by retaining adequate levels of antibodies produced during earlier infection in the body.
   (f) Blood fails to clot in people suffering from________.
   (g) Blood is divided into groups depending on certain substances, ________ and ________ present in it.

(h) The two large viens which return the impure blood to the heart are __________ and __________.

(i) Pulmonary artery carries __________ blood from the __________ to the __________.

9. Match the following:

A	B
(a) Pericardium	(1) carries oxygenated blood.
(b) Coronary artery	(2) due to the presence of a blood clot in the coronary artery.
(c) Pulmonary vein	(3) protective covering of the heart.
(d) Lymph	(4) insufficient oxygen supply to heart muscles.
(e) Coronary thrombosis	(5) fluid that bathes all the tissues of the body.
(f) Tonsils	(6) supplies blood to heart muscles.
(g) Angina pectoris	(7) an example of lymphatic tissue.

6

Excretory System

Life is possible because of certain metabolic activities taking place continuously in the living cells. The chemical activities are often accompanied by the formation of waste products. Carbon dioxide and water are the metabolic wastes of carbohydrates and fats, and ammonia is one of the byproducts of protein metabolism as shown in Fig. 6.1. Accumulation of wastes, especially non-protein nitrogenous wastes such as **urea**, **uric acid**, etc., formed as a result of protein metabolism induces **tissue poisoning**. This happens because the tissues when filled with waste products, become incapable of absorbing food and oxygen. The tissues get starved and suffocated.

To prevent the accumulation of the waste materials they must be eliminated. The pro-

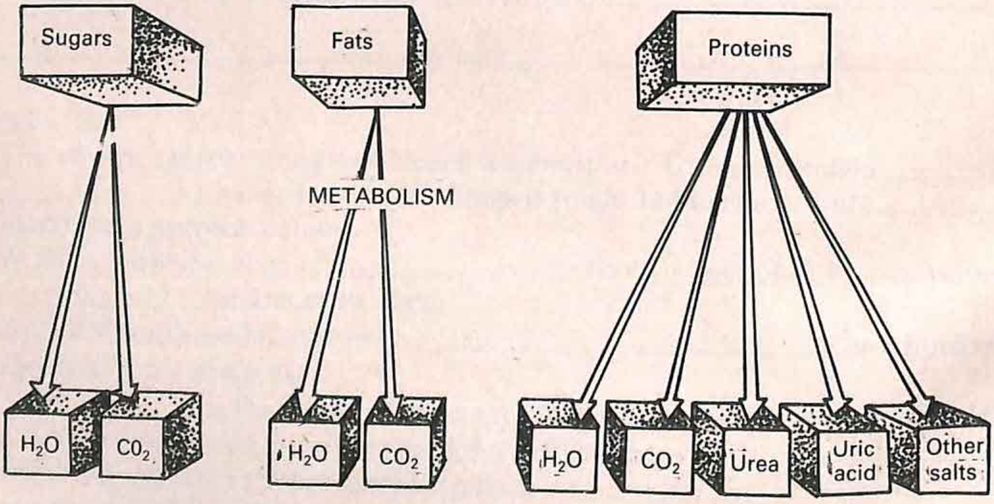


Fig. 6.1 Waste products of metabolism of sugars, fats and proteins.

cess of *elimination of the metabolic wastes from the body, in order to maintain the individual's health*, is known as **excretion**. Different organisms have different ways of carrying out excretion. In some organisms the skin forms the organ of excretion while in the more complex beings other organs of excretion such as kidneys, have been devised by Nature. Let us now study about the excretory organs in details.

6.1 The Excretory System in Lower Organisms

In lower organisms such as amoeba and paramecium, the **contractile vacuole** eliminates waste products by successive contractions. The metabolic wastes directly diffuse out of the cells where they are produced, into the surrounding water. In larger organisms since the direct diffusion of the wastes to the exterior would be slow, they have specialised organs for elimination of wastes.

Earthworms and other invertebrates have tubular excretory structures called **nephridia**, which open into the body cavity. In the case of insects the nitrogenous wastes are excreted through **Malpighian tubules**. However, the higher organisms have a highly specialised excretory system.

6.2 Excretory Organs in Mammals

The excretory organs in mammals consist of a pair of **kidneys**, a pair of **ureters**, **a urinary bladder** and **urethra**, Fig. 6.2. The kidneys are *bean-shaped* organs located on either side of the backbone, in the abdominal cavity. Each kidney is covered by a transparent membrane. A longitudinal section of the kidney shows three distinct regions; the outer **cortex**; inner **medulla**; and a sac-like cavity called the **renal pelvis**, Fig. 6.3. The renal pelvis leads to a long narrow tube (one from each kidney) called the ureter. The two ureters carry the urine from the pelvis to the urinary bladder which opens to the exterior through an opening called the urethra.

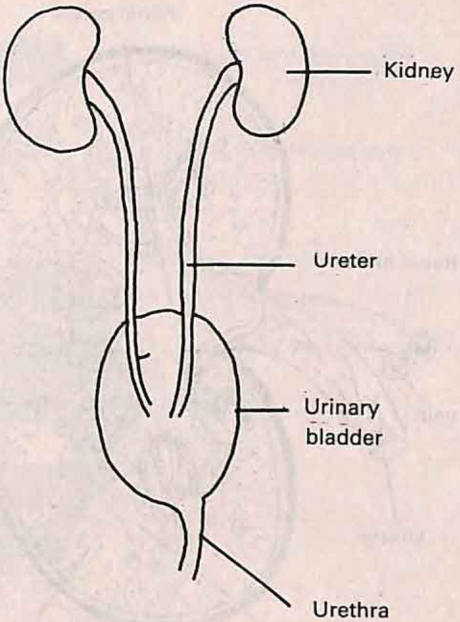


Fig. 6.2 Excretory organs in man.

The cortex and medulla of each kidney are made up of approximately one million minute structures called **nephrons**. These are the *structural* and *functional* units of the kidneys. Each nephron consists of a long, coiled tubule which begins in the cortex as a double-walled cup called the **Bowman's capsule.** This capsule continues as a highly coiled tubule towards the medulla. A number of such nephrons join together and open towards the renal pelvis.

Oxygenated blood enters each kidney through a **renal artery** while the **renal vein** takes away the *deoxygenated* blood from them. The renal artery branches and rebranches to form a mass of capillaries inside each Bowman's capsule. This network of capillaries is called **glomerulus**. The

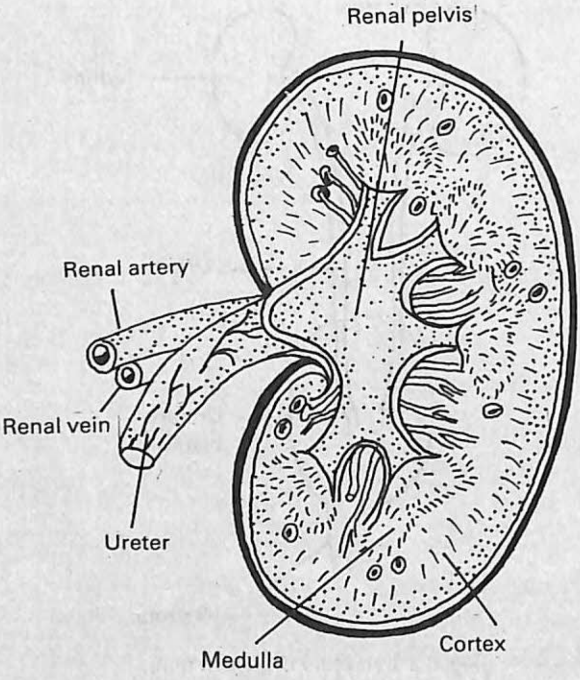


Fig. 6.3 A longitudinal section of the human kidneys.

glomerulus is separated from the space within each Bowman's capsule by a few thin layers of tissues. The functional significance of this arrangement is that this thin barrier allows the filtration of the fluid from the capillaries into the Bowman's capsule, Fig. 6.4. All these organs work together efficiently to purify the blood of all its metabolic wastes.

6.3 The Process of Excretion

As stated earlier, as a result of protein metabolism, ammonia is produced as a byproduct. Ammonia is highly toxic to the cells, so it is combined with carbon dioxide in the liver to form a less toxic substance called urea. The urea thus formed is brought to the kidney by the blood stream. As the blood passes through the glomerulus water, nitrogenous waste (urea), glucose and mineral salts diffuse through the walls of the capillaries into the Bowman's capsule. This solution then passes from the Bowman's capsule into the highly coiled tubule.

As it passes through the tubule, useful substances such as glucose, mineral salts, etc., are reabsorbed into the blood. If the amounts of mineral salts and water in the blood are *less* than the normal requirement, the tubule of the kidney will reabsorb them and *will not* allow them to pass out along with urine. On the other hand if we drink a large quantity of water a large amount of urine is produced. Thus, only the nitrogenous wastes, excess water and mineral salts pass out of the tubule into the pelvis as urine.

Urine formation is a continuous process. Urine is drained from several nephrons into the pelvis from where the ureters carry it to the urinary bladder. When the bladder is filled with urine, the latter is forced out through the urethra. This process of urine formation is performed in all vertebrates though the nephrons may get structurally and functionally adapted to the specific environment in which the vertebrates live.

The foregoing discussion helps us to understand not only how the kidneys function as an organ of excretion but also how they continuously regulate the chemical composition of the blood. They do so irrespective of the nature of food or fluid intake.

6.4 Skin as an Organ of Excretion

The skin helps in excreting certain waste products such as water, mineral salts and some amount of urea. In addition to its excretory function, the skin protects the underlying tissues. It helps in maintaining a constant body temperature of 98.4°F. By studying the different layers of the skin we can understand better the various functions that it performs. The

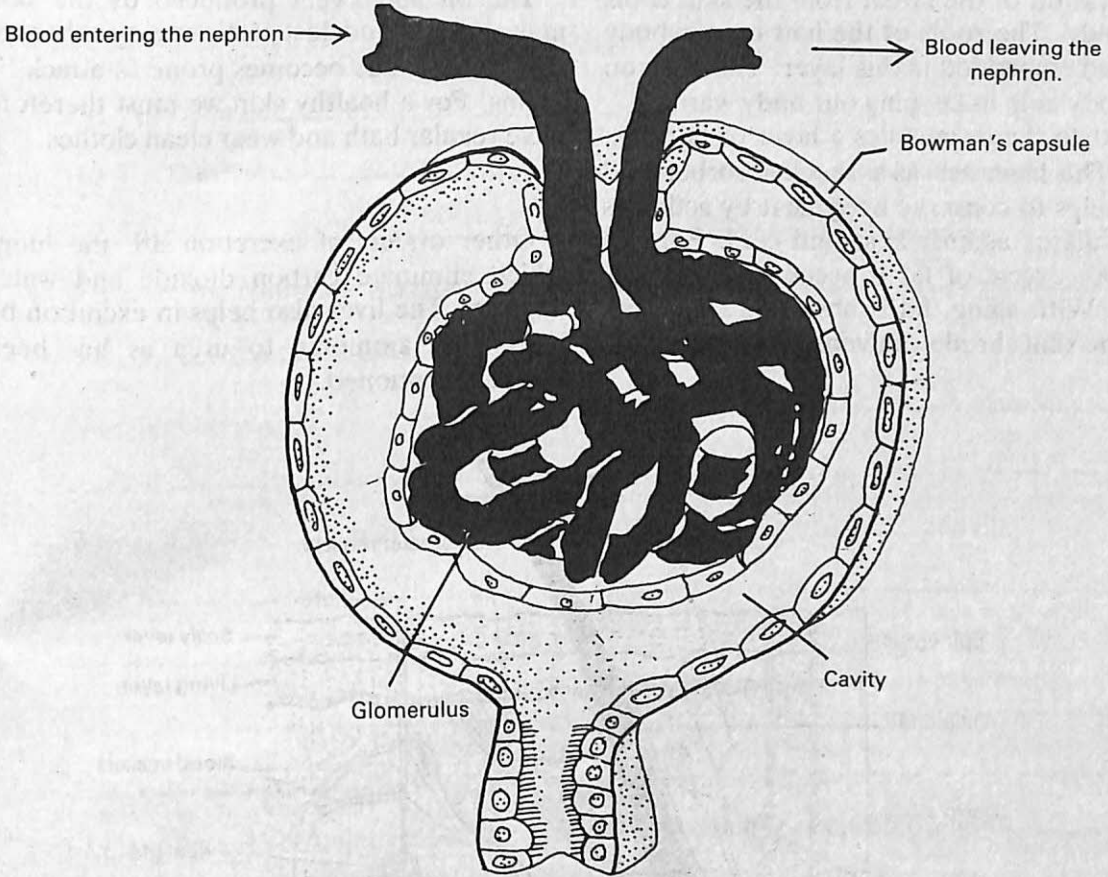


Fig. 6.4 A magnified view of the Bowman's capsule of a nephron.

skin consists of an outer layer called **epidermis** composed of many layers of cells.

By continuous division, the lower lying cells of the epidermis form new cells which move outwards. The outer cells undergo changes due to the deposition of some protein material which gives them a flattened and scaly texture. This layer forms an ideal barrier against the invasion of germs. The cells of the epidermis contain a pigment called **melanin** which is responsible for the colour of the skin. The difference in the colouring of the skin is due to the difference in the amounts of melanin. It may be noted that hair and nails are the outgrowths of the epidermal layer.

Below the epidermis lies the **dermis**. This is a thick *living* layer and is made up of fibrous connective tissue about which you have studied in your earlier class. The dermis is richly supplied with **blood vessels**, **nerves** and **oil glands**. The nerves help the skin to sense the changes in the external environment (see chapter on Nervous System). The oil secreted by the oil glands (**sebaceous glands**) keeps the skin smooth and soft. The **sweat glands** present in this layer produce sweat which contains water and mineral salts.

The sweat is brought to the surface of the skin by **sweat ducts** which open to the exterior through the **pores** on the skin, Fig. 6.5. The evaporation of the sweat from the skin cools our body. The roots of the hair on our body are also embedded in this layer. The hairs on our body help in keeping our body warm.

Next to the dermis lies a layer of fatty tissues. This layer acts as a 'shock absorber' and also helps to conserve body heat by acting as an insulator against heat and cold. For this purpose excess of fat is accumulated in this layer. With aging, fat is absorbed from here and the skin shrinks unevenly, causing wrinkles.

The oil and sweat produced by the skin make it sticky and dust particles may adhere to it. The skin thus becomes prone to attack by germs. For a healthy skin we must therefore have regular bath and wear clean clothes.

Other organs of excretion are the lungs which eliminate carbon dioxide and water vapours. The liver also helps in excretion by converting ammonia to urea as has been already mentioned.

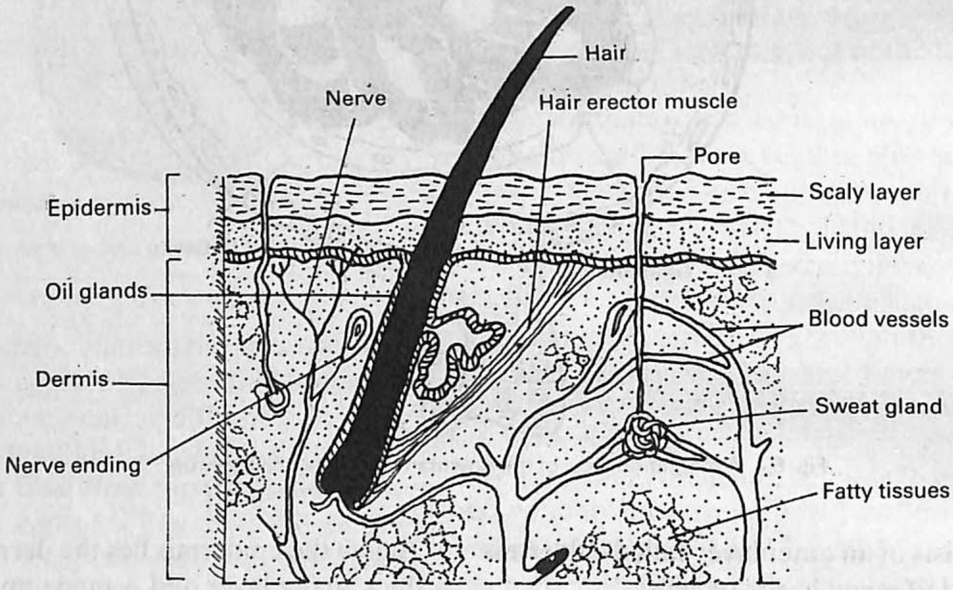


Fig. 6.5 Skin as an organ of excretion.

EXERCISES

1. What is excretion? ______________________________

2. Name the excretory organs of the following organisms:

   (a) Amoeba____________________________

   (b) Earthworm____________________________

   (c) Insects____________________________

3. What are the common excretory products?________________

4. Why is it necessary to remove metabolic wastes?________________

5. Explain the role of kidneys in maintaining a constant composition of blood.________

6. Give a brief outline of the structure of nephrons.________________

7. Give the functions of the following:

(a) Epidermis ____

____

____

____

(b) Dermis ____

____

____

(c) Fatty tissue ______________________________________

____

____

(d) Oil glands _______________________________________

____

(e) Sweat glands _____________________________________

____

8. Put a mark against the correct answers.
   (a) They are the structural and functional units of the kidneys.
   (ureters/nephrons/glomerulus)
   (b) It forms the outer region of the kidneys.
   (medulla/renal pelvis/cortex)
   (c) It is a double-walled, cup-like structure found in each nephron.
   (renal artery/urinary bladder/Bowman's capsule)
   (d) It is a network of capillaries present in each Bowman's capsule.
   (urethra/glomerulus/kidney)
   (e) It gives colour to the skin.
   (melanin/fatty tissue/dermis)
   (f) If acts as a 'shock absorber'.
   (sweat duct/pores/fatty tissue)
   (g) It forms a barrier against the entry of germs.
   (nerves/epidermis/dermis)

7

Nervous System

Of all the systems of our body the most highly developed and complex is the nervous system. It can be called the *communication network* of the body. It enables us to have contact with the surrounding environment. It tells us when we are tired or when we are sleepy. It controls the muscles of our body and hence their movements and is responsible for our behaviour, thinking capacity and feelings. It helps us to give a quick response to the changes in the external as well as the internal environment.

The nervous system consists of the **brain**, the **spinal cord** and the **nerves** coming out from them, Fig. 7.1.

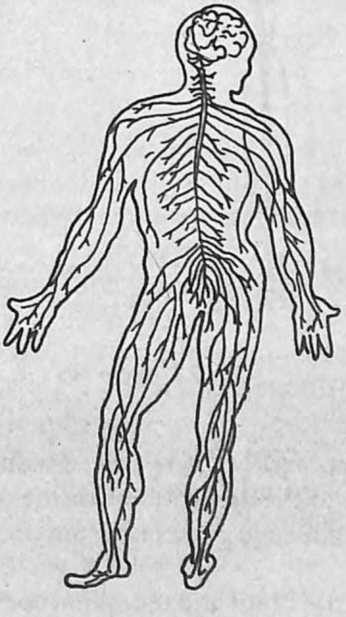


Fig. 7.1 The nervous system

7.1 The Nerve Cell

The brain and the spinal cord are connected to the different parts of our body through a network of nerve cells or **neurons**. The neurons are specialised cells for the transmission of impulses. Each neuron consists of a cell body containing a nucleus, a number of fine thread-like processes extending from the cell body. The short and branching processes are called the **dendrites** and the long, thin process is called the **axon**.

Each nerve cell has only one axon. The axon of each cell branches at its end and these branches come closer to the dendrites of another cell. The space between the dendrites of one cell and the axon of another is known as the **synapse**, Fig. 7.2. The message that passes

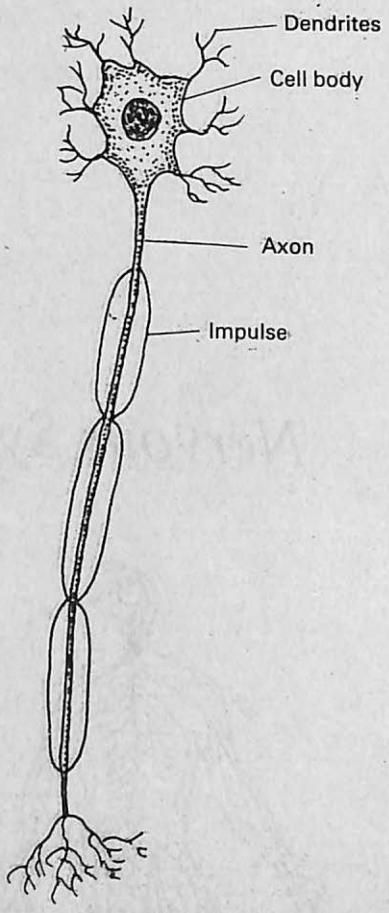


Fig. 7.2 Nerve cell

along the axon of one cell crosses over the synapse to the dendrites of the next cell. Like this the message passes on from one cell to the other.

Both the brain and the spinal cord consist of **grey matter** and **white matter**. Cell bodies of the neurons gather together to form the grey matter and the nerve fibre forms the white matter.

Any change in the environment, known as **stimulus** (plural **stimuli**) is detected by the sense organs. The sense organs are the organs of touch, smell, sight, hearing and taste. They are also known as the **receptor organs** as they receive the stimuli from the surroundings. The nerve fibres that carry messages from the receptor organs to the brain or spinal cord are called **sensory nerves**. Instructions from the brain or spinal cord is carried by another set of nerves known as **motor nerves**. The motor nerves carry the message to the muscles or glands.

7.2 The Brain

The brain is the most specialised part of the nervous system. It is protected by the skull. The membrane covering the brain is called the **meninges**. The brain consists of three regions the **cerebrum**, the **cerebellum** and the **medulla oblongata**, Fig. 7.3. Cerebrum is the largest part of the brain.

It consists of two halves or hemispheres. Outer surface of these hemispheres is called the **cortex** and is deeply folded into irregular furrows. These furrows increase the surface area of the brain. The remarkable growth of the cerebral cortex in human beings accounts for their ability of learning, reasoning, memorising, imagination, speech, etc. It controls all conscious activities.

Below the cerebrum is the oval shaped cerebellum or the 'little brain'. It helps in the maintenance of balance in our body, controls the muscles and co-ordinates their movements. It also conveys all messages that it receives from the medulla to the cerebrum.

The **medulla oblongata** is present at the very base of the brain and continues to form the spinal cord. It controls all involuntary muscular activities such as heart beat, breathing, secretion of glands, etc.

7.3 The Spinal Cord

Spinal cord is a long, cylindrical mass of nerv-

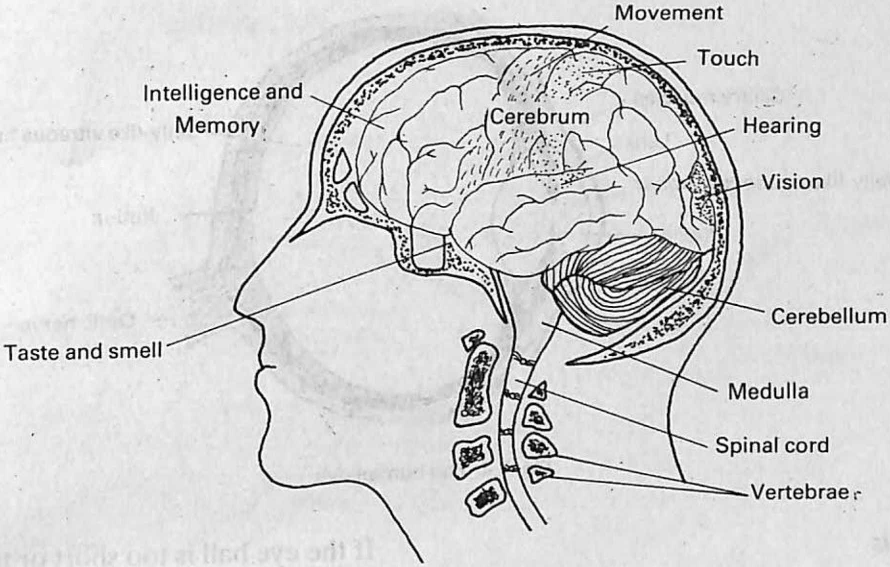


Fig. 7.3 Human brain.

ous tissue and passes through the vertebral column. It is also surrounded and protected by the meninges. It serves as an important reflex centre. Some times when our hand touches some hot object it is involuntarily removed due to muscular contractions. This involuntary action is called **reflex action**. Other examples of reflex actions are, closing of eyes when a strong light is flashed on them, secretion of saliva at the sight or smell of food, etc.

7.4 The Sense Organs

In higher animals certain cells are highly specialised. They are sensitive to particular stimuli. These group of cells or **sense organs** as they are called, pick up the stimuli and pass them along to the brain for processing. The eyes, ears, nose, tongue and skin are the sense organs as they help us to detect the changes around us. The sensations are registered in the cerebral cortex. They provide us with a storehouse of impressions.

The Eyes

The eyes, situated in the sockets of the skull, work on the same basic principle as a camera. They are protected by the **eye lids** and the **eye brows.** The rays of light coming from the surrounding objects are directed, through the pupil on to a lens, held in position by ligaments, Fig. 7.4. Contraction and relaxation of the muscles of these ligaments can flatten the lens or make it more spherical. These changes in the shape of the lens enables the eye to shift its focus to far off or nearby objects.

The lens focusses the light on the light-sensitive nervous tissue, **retina**, which is made up of **rod cells** and **cone cells**. Rod cells are responsible for vision in *dim light* and cone cells, in *bright light*. Cone cells also help in the perception of colour. The image of the object is formed on the retina. The sensory impulses are received by minute nerves that join up to form the **optic nerve**, which conveys the impulse to the brain. The brain then interprets the impulse and sends the message to the eyes and we finally see the object.

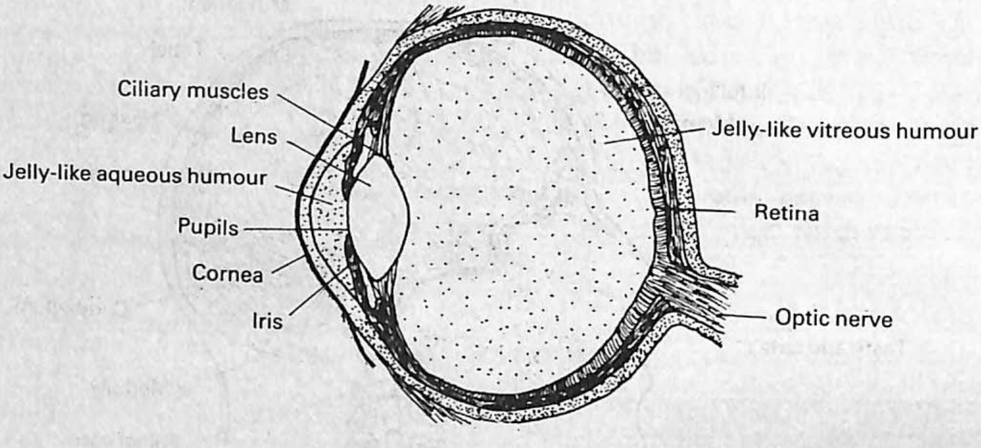
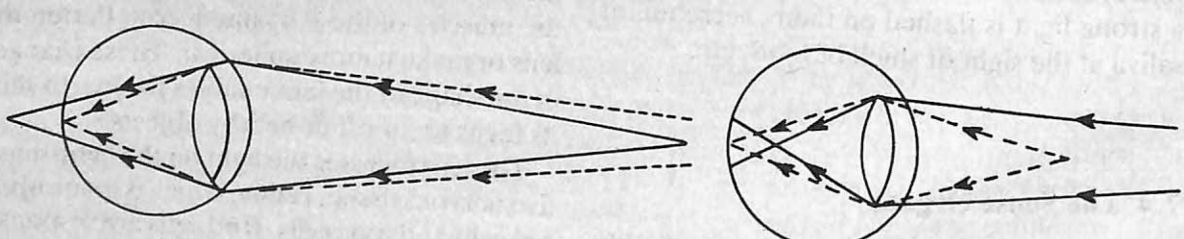


Fig. 7.4 The human eye

Eye Defects

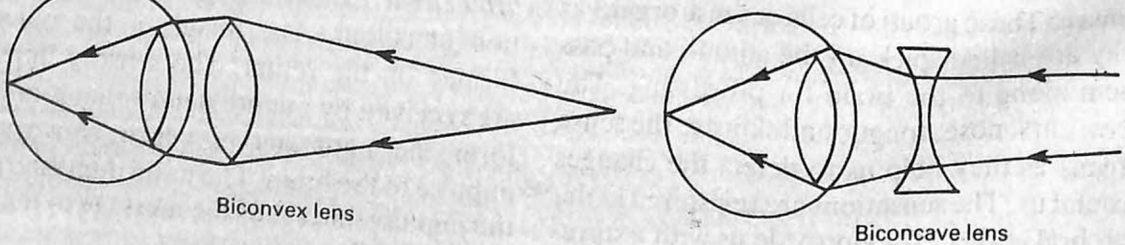
For the normal functioning of the eyes vitamin A is essential because rod cells contain a substance, **rhodopsin**, which is made up of vitamin A and proteins. We must include vegetables like carrots, pumpkin, papaya, spinach, etc., in our diet, as these are rich sources of vitamin A. If this vitamin is lacking in a person's diet, he will be unable to see in dim light. This condition is known as **night blindness**.

If the eye ball is too short or the lens flatter than normal, then the rays reflected from nearby objects get focussed *behind* the retina, but the rays of the far-off objects are focussed properly on it. This condition is known as far-sightedness or **hypermetropia**. Mostly, old people suffer from this condition as their lens becomes less flexible. Eye glasses fitted with convex lens can correct this condition, as shown in Fig. 7.5.



Light rays focussed beyond the retina.

Light rays focussed in front of the retina.



Biconvex lens

Biconcave lens

Fig. 7.5 Defects of the eye.

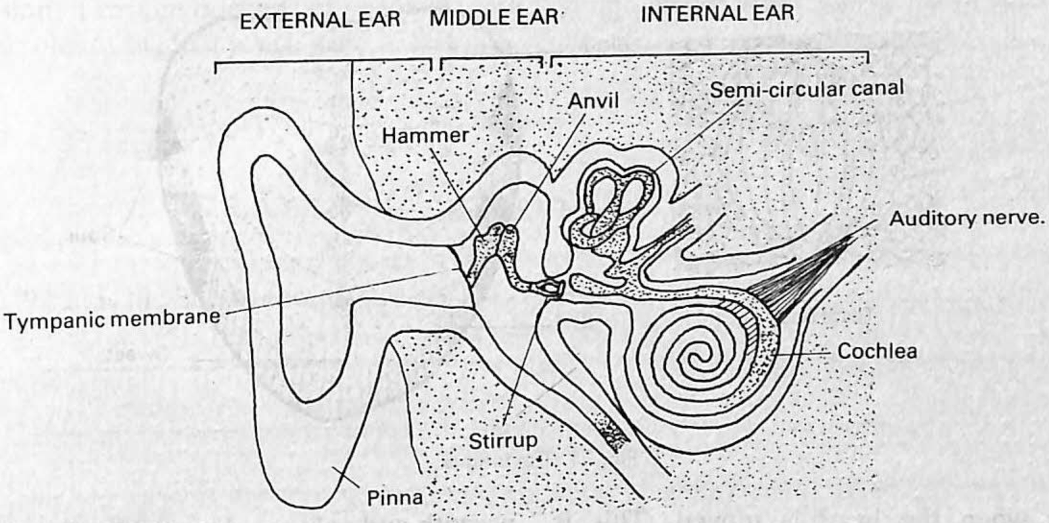


Fig. 7.6 The ear

If the eye ball is too long or the lens is more spherical, the images from the distant objects are focussed in *front* of the retina. This leads to an inability to see distant objects clearly. However, the rays from the nearby objects are focussed properly on the retina. This condition is known as shortsightedness or **myopia**. Eye glasses with concave lens can correct this condition, Fig. 7.5.

If the lens develops uneven areas the light rays entering the eye will not be brought to focus at a single point. This defect is known as **astigmatism** and can be corrected by using a special type of eye glass.

The lens is transparent in the case of a healthy eye. Sometimes, in people over fifty years of age, a scaly growth develops in the lens. This condition is called **cataract** and can lead to partial or complete blindness. In such cases, the lenses are removed surgically and special eye glasses are provided to compensate for the loss of vision.

The Ears

The ear can be divided into three parts—the external, middle and inner ear, as shown in Fig. 7.6. The external ear consists of the earflap or **pinna** which serves to concentrate the sound. Sound waves travel through the ear opening and vibrate the eardrum or **tympanic membrane**. The middle ear consists of three small moveable bones called **stirrup**, **anvil** and **hammer**. These help to transmit the sound to the inner ear.

The inner ear contains three **semi-circular canals** and a coiled structure full of fluid called **cochlea**. When the sound vibrations are received in the inner ear the fluid in the cochlea starts vibrating. These vibrations are detected by nerve cells in the cochlea and transmitted to the brain through the **auditory nerve**.

Semi-circular canals in the inner ear help to provide balance and a sense of position in the body. The canals are filled with a fluid which

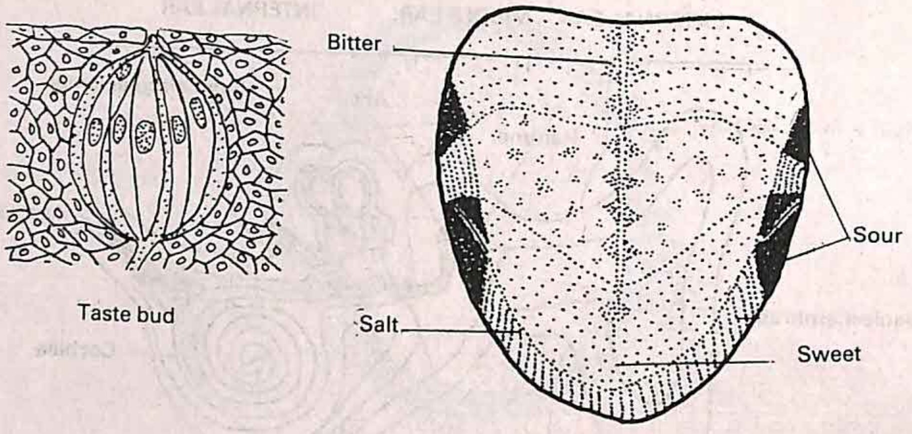


Fig. 7.7 The tongue.

moves when the head is moved. This is detected by nerve cells and carried to the brain. The dizziness that one feels after going round and round for some time is because of the movement of this fluid.

The Nose

The sense of smell is perceived by the nose. Much of the taste of food is due to its flavour. As you chew the food, the vapours entering the nose are detected by nerve endings in the nasal passage. The impulses generated in the nerve endings are carried through the **olfactory nerves** to the cerebrum where they are interpreted. Compared to many animals the sense of smell is poorly developed in man.

The Tongue

We know the taste of all that we eat with the help of the tongue. The four basic tastes are salty, sweet, bitter and sour. These are detected by nerve endings called **taste buds** in the tongue. Taste buds are distributed over the front, sides and back of the tongue, Fig. 7.7.

The Skin

The sensation of touch, pressure, pain, warmth and cold are detected by the sensory nerve endings in the skin, Fig. 7.8. The skin can be broadly divided into two layers—the **epidermis** and the **dermis**. The epidermis is the outer layer which contains melanin, the pigment responsible for the colour of the skin. The dermis is the layer next to the epidermis. It contains blood vessels, nerve endings, oil producing (**sebaceous**) glands, sweat glands and the hair root.

The skin protects the body against bacteria and virus. It also controls the water loss and thus regulates the body temperature. Another function of the skin is to protect the body

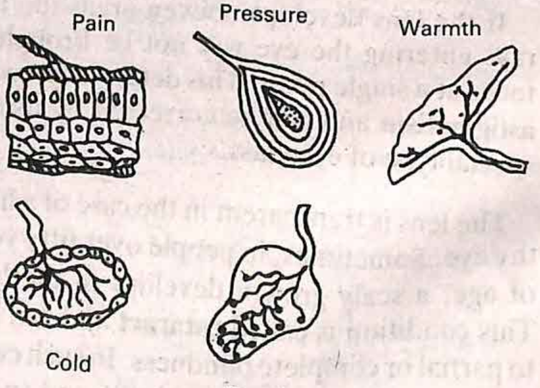


Fig. 7.8 The nerve endings in skin which indicate the different sensations.

against friction and other external pressures. The skin of certain portions of our body such as the soles of the feet which have to face constant pressures and friction, are therefore very tough. For further details about the skin see chapter or Excretory System.

EXERCISES

1. What is the importance of the nervous system?

2. Draw a labelled diagram of the neuron.

3. What are receptor organs? How do these help us to know the changes in the environment?

4. Give the functions of the following:

(a) Cerebrum

(b) Cerebellum

(c) Medulla oblongata

5. What do you mean by reflex action?

6. If an object is placed in front of you how would your eyes help you to see the object?

7. Fill in the blanks:
   (a) ______________ are responsible for vision in dim light while the cone cells are for vision in ______________ ______________.
   (b) ______________ nerves convey the impulse to the brain.
   (c) ______________ present in rod cells, is made up of vitamin A and proteins.
   (d) The space between the dendrites of one cell and the axon of another is known as the ______________.
   (e) ______________ is a membrane covering the brain.
   (f) When rays from nearby objects get focussed behind the retina it is know as __________.
   (g) When a patient suffers from ______________ the light rays are not brought to focus at a single point.
   (h) The middle ear consists of ______________, ______________ and ______________.
   (i) ______________ is the pigment which gives colour to our skin.
   (j) The skin protects the body from ______________ and ______________.
8. State whether the following statements are true or false.
   (a) Grey matter and white matter are present in the brain as well as the spinal cord.
   (b) The cerebral cortex helps in maintaining balance in our body and coordinates the muscle movements.
   (c) Auditory nerve carries impulses entering the ear to the brain and helps us to see.
   (d) Instructions from the brain or spinal cord are carried by the motor nerves.
   (e) Olfactory nerves help us to smell the food we eat.

8

The Endocrine System

In multicellular animals there is always a division of labour among the different systems of the body. For instance, the digestive system helps in the digestion of food, the circulatory system helps in the transport of substances within the body, the muscular system helps in movements and so on. In order to make the various systems function systematically, the body requires a 'master mind' which could coordinate their activities. The **endocrine system** acts as the master mind.

The endocrine system consists of the **endocrine glands**, which pour their chemical secretions known as **hormones**, directly into the blood stream. These glands have no ducts and are therefore also known as the **ductless glands**. Hormones are growth regulators and control various biological functions. They are transported to different parts of the body by the blood stream. Though they are carried to all parts of our body, only a particular organ responds to a particular hormone. Such an organ is called the *target organ*. Here also, only a certain group of cells respond and these cells are known as *target cells*.

Our knowledge about hormones is restricted to their study in man and other vertebrates. But certain hormones have been found in insects also. Let us now study the variety of hormones produced by the endocrine glands and their effects.

8.1 Pituitary Gland

This is a small gland located at the base of the brain, Fig. 8.1. Its secretions can influence the activity of the other endocrine glands. A number of hormones are secreted by this gland and a variety of functions are controlled by them. These hormones influence activities such as the growth of bones, milk secretion from the mammary glands, development of ovaries and testes, functioning of the kidney, etc.

If the pituitary gland is *underactive*, and the quantity of hormones is *less* than that required by our body, physical development is retarded. In this case, growth tends to be stunted and this condition is called **dwarfism**. When the pituitary gland is *overactive*, resulting in *excess* of hormones, the individual grows abnormally huge and this condition is known as **gigantism**.

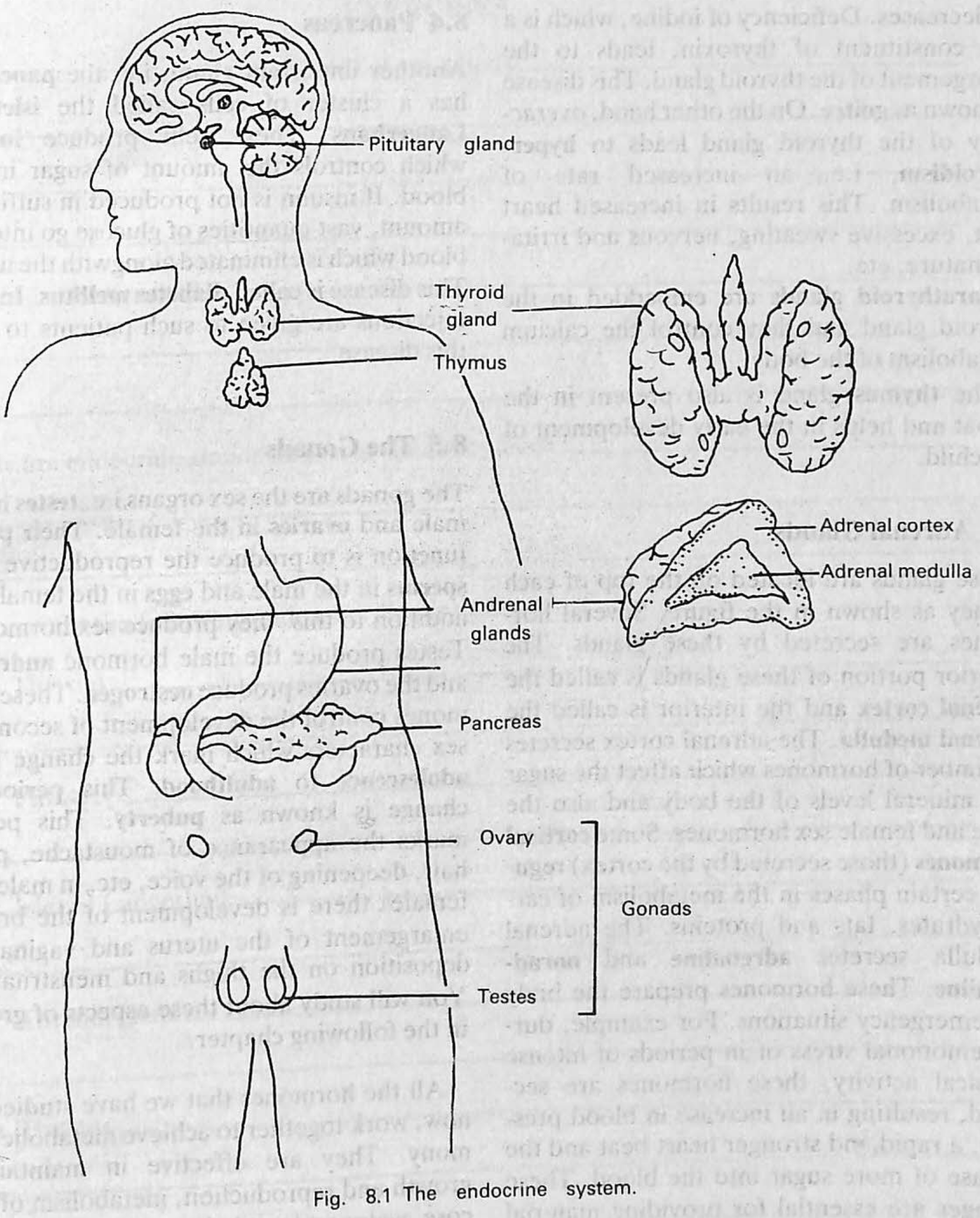


Fig. 8.1 The endocrine system.

8.2 Thyroid Gland

This gland is present in the neck, near the trachea and secretes a hormone called **thyroxin**. Its main function is to regulate the rate of metabolism, i.e. all biochemical reactions. *Underactivity* of the thyroid gland leads to **hypothyroidism** due to which metabolic activity decreases. Deficiency of iodine, which is a rich constituent of thyroxin, leads to the enlargement of the thyroid gland. This disease is known as **goitre**. On the other hand, *overactivity* of the thyroid gland leads to **hyperthyroidism**, i.e., an increased rate of metabolism. This results in increased heart beat, excessive sweating, nervous and irritable nature, etc.

Parathyroid glands are embedded in the thyroid gland and they control the calcium metabolism of the body.

The **thymus** gland is also present in the throat and helps in the early development of the child.

8.3 Adrenal Glands

These glands are located on the top of each kidney as shown in the figure. Several hormones are secreted by these glands. The exterior portion of these glands is called the **adrenal cortex** and the interior is called the **adrenal medulla**. The adrenal cortex secretes a number of hormones which affect the sugar and mineral levels of the body and also the male and female sex hormones. Some **cortical hormones** (those secreted by the cortex) regulate certain phases in the metabolism of carbohydrates, fats and proteins. The adrenal medulla secretes **adrenaline** and **noradrenaline**. These hormones prepare the body for emergency situations. For example, during emotional stress or in periods of intense physical activity, these hormones are secreted, resulting in an increase in blood pressure, a rapid and stronger heart beat and the release of more sugar into the blood. These changes are essential for providing material for increased oxidation in times of emergency.

8.4 Pancreas

Another important gland, i.e., the **pancreas**, has a cluster of cells called the **islets of Langerhans**. These cells produce **insulin** which controls the amount of sugar in the blood. If insulin is not produced in sufficient amount, vast quantities of glucose go into the blood which is eliminated alongwith the urine. This disease is called **diabetes mellitus**. Insulin injections are given to such patients to cure this disease.

8.5 The Gonads

The gonads are the sex organs, i.e., **testes** in the male and **ovaries** in the female. Their prime function is to produce the reproductive cells **sperms** in the male and **eggs** in the female. In addition to this they produce sex hormones. Testes produce the male hormone **androgen** and the ovaries produce **oestrogen**. These hormones control the development of secondary sex characters which mark the change from **adolescence** to **adulthood**. This period of change is known as **puberty**. This period marks the appearance of moustache, pubic hair, deepening of the voice, etc., in males. In females there is development of the breast, enlargement of the uterus and vagina, fat deposition on the thighs and menstruation. You will study about these aspects of growth in the following chapter.

All the hormones that we have studied till now, work together to achieve metabolic harmony. They are effective in maintaining growth and reproduction, metabolism of glucose, water and salt balance, and heat regulation in the body.

EXERCISES

1. Name the various endocrine glands of your body.

2. What are hormones?

3. Why are endocrine glands known as ductless glands?

4. Where are the following endocrine glands located?

   (a) Thyroid

   (b) Pituitary

   (c) Islet of Langerhans

   (d) Adrenal gland

   (e) Thymus

5. Which gland secretes insulin?

6. Write briefly about the following:

Hyperthyroidism ______________________________

____

____

____

Hypothyroidism ______________________________

____

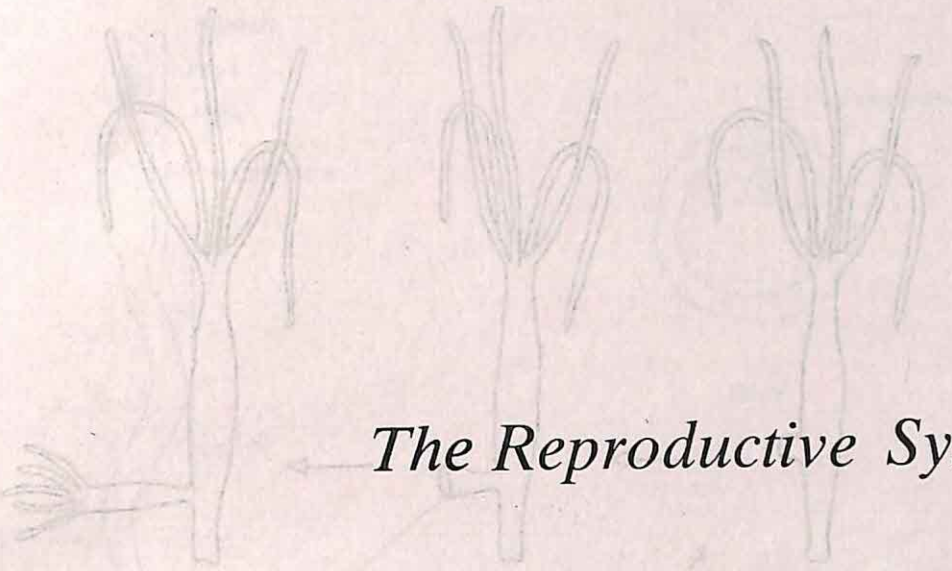
____

____

7. Fill in the blanks:
   - (a) The hormone which controls the development of male sexual characters is called ______________.
   - (b) The hormone that prepares the body for emergency situations is known as ______.
   - (c) Deficiency of iodine leads to the enlargement of thyroid gland. This disease is known as ______________.
   - (d) Female hormone produced by the ovary is known as ______________
   - (e) ______________ gland is responsible for child development.

8. Match the following:

(a) Thyroxin	(1) produce the female reproductive cell, the eggs.
(b) Adrenal cortex	(2) hormone produced by the testes.
(c) Ovaries	(3) produced by the thyroid gland.
(d) Puberty	(4) exterior portion of the adrenal glands
(e) Androgen	(5) transition from adolescence to adulthood.



9

The Reproductive System

All living beings on this earth live for a certain period of time. If within this period they are not able to produce more individuals of their kind, their species would be completely wiped out. So to maintain the *continuity of a species* and to ensure the *continuity of life itself*, all living organisms produce new individuals similar to themselves. This is known as **reproduction**. In certain types of insects only some of its members are capable of reproduction, for e.g., bees. In this group of insects, majority of them are workers, who cannot reproduce. Few individuals of the hive are males and only the queen bee can produce eggs.

There are two main types of reproduction, **asexual** and **sexual**. Asexual reproduction involves the multiplication of the species of an organism without the involvement of reproductive cells. In one of this type of reproduction the cells of the parents may divide into two and the new individual then separates from the parent. This type of reproduction is known as **binary fission**. In amoeba one cell divides to form two daughter cells.

When the parent divides into several individuals it is known as **multiple fission**. **Budding** is another type of asexual reproduction where a new individual is produced as an outgrowth from the body of the older individual. This bud later gets detached from the parent-body and becomes a new individual. Hydra and many coelenterates reproduce by budding, Fig. 9.1.

Some of these animals do not depend on asexual reproduction alone. Sexual reproduction takes place side by side. Some plants and animals have the power of *regeneration*. These species are able to grow back any part of their body that is lost. This is however mainly evident in plants and lower animals. Amoeba, paramecium, hydra, planaria and starfishes are few examples of species with this power.

You must have observed a lizard grow back its lost tail. In hydra and planaria this is also a means of asexual reproduction. They divide longitudinally (lengthwise) and each half regenerates the lost half. The wounds and injuries in mammals get healed by this process of regeneration.

Sexual reproduction involves the fusion of the male and female reproductive cells. The males and the females are distinguished on the

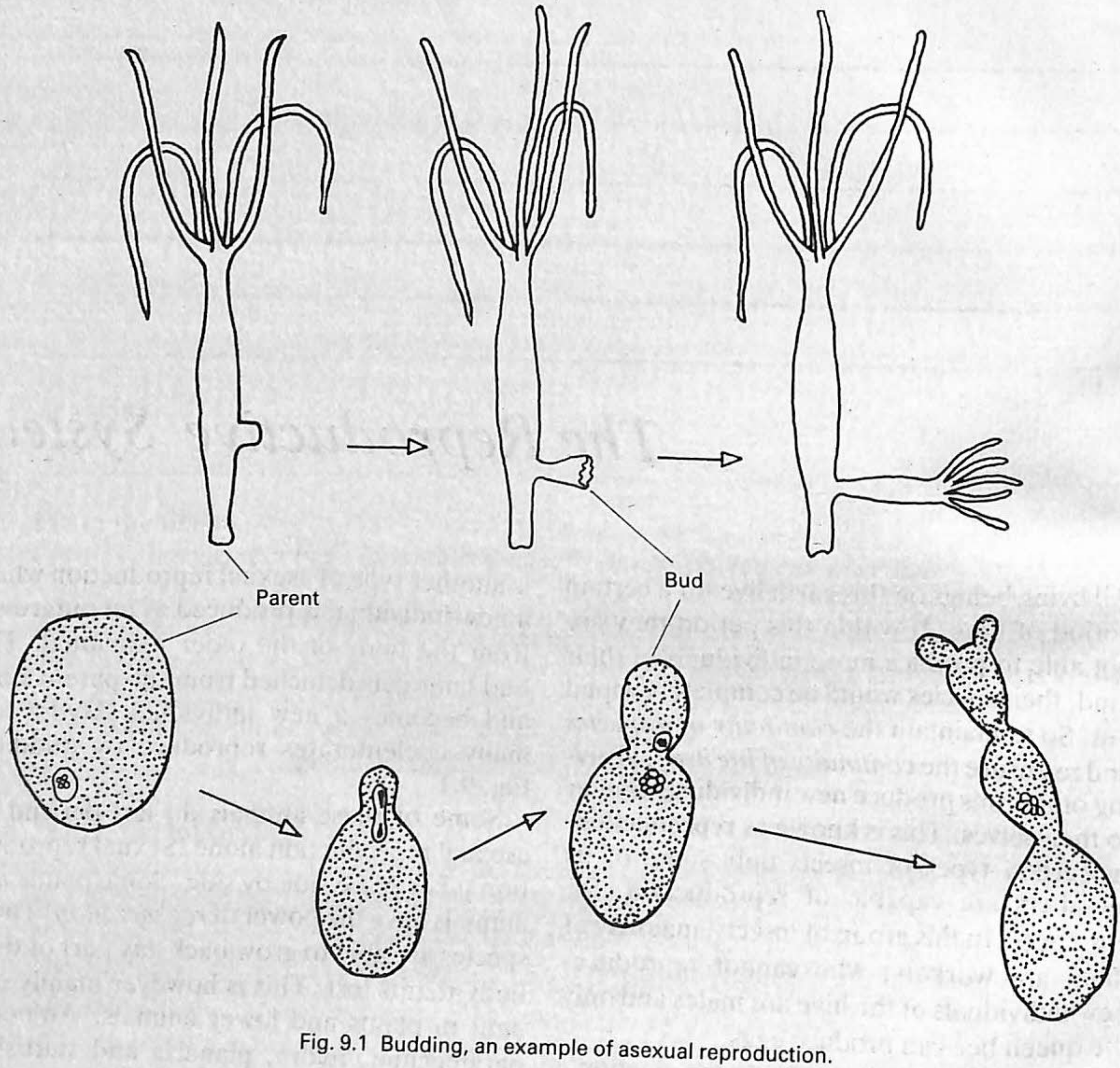


Fig. 9.1 Budding, an example of asexual reproduction.

basis of the type of reproductive cells they produce. When one individual carries only the male and another only the female reproductive cells, they are called **unisexual**. But in certain invertebrates such as earthworms, the same individual possesses both the types of reproductive cells. Such life-forms are called **hermaphrodites**. Hermaphrodites are, however, rare among vertebrates.

9.1 Sexual Reproduction

This form of reproduction is most common in animals and also in man. The individuals have special organs for the production of reproductive cells called **gametes**. These special organs are called gonads about which you already know. The testes produce the male gametes or **sperms** in large numbers at a time.

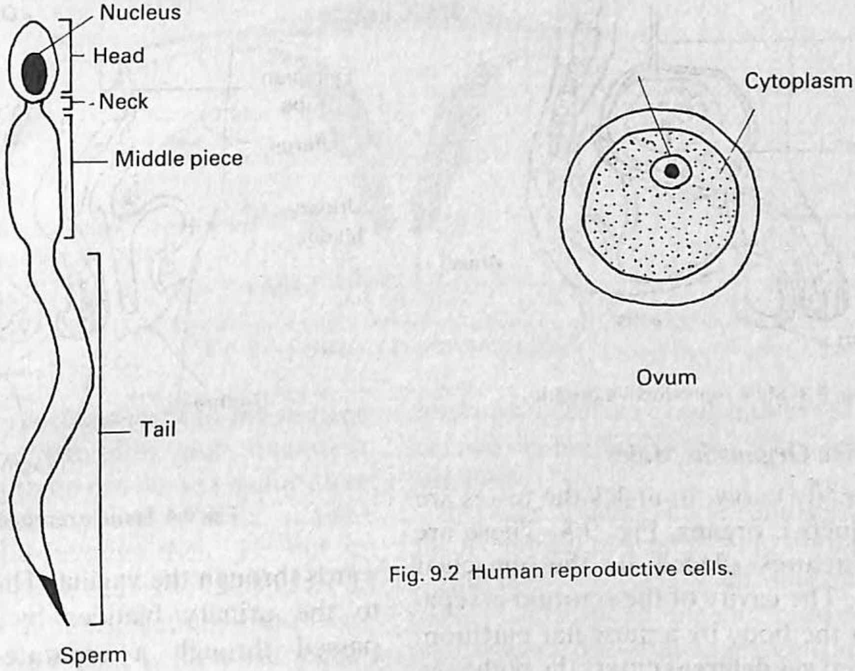


Fig. 9.2 Human reproductive cells.

The sperms have a head, a neck and a tail, by the flaying movement of which the sperms move, Fig. 9.2. The ovary produces the female gamete, the **ovum** (plural ova), one at a time. The ovum is spherical or oval in shape and is *immobile*. The yolk present in the ovum nourishes the developing embryo (Fig. 9.2).

In sexual reproduction fusion of the sperm and ovum occurs. This phenomenon is known as **fertilization** and the fused cell is known as the **zygote**. In unisexual animals, close proximity of both the sexes is essential for fertilization to occur. In some fishes and amphibians both the reproductive cells are released in water, where fertilization occurs.

In reptiles, birds and mammals, the male reproductive cells are introduced in the female reproductive tract and union of the sperm and ovum takes place inside the female's body. In all higher animals sexual reproduction is confined to a particular season when chances of survival of the young ones are maximum. This is known as the **breeding** season. Human beings are the only exception to this.

9.2 Reproductive System in Human Beings

The reproductive organs in the human beings i.e. testes and ovaries start functioning from the age of 10-11 years in females and from the age of 13-14 years in males. This period of transition, when the individual becomes an adult from an adolescent, is known as **puberty**. The testes and ovaries also produce the male and female sex hormones, respectively which are responsible for the development of *secondary sexual characters*. These include the appearance of breasts and growth of pubic hair in females. In males there is growth of pubic hair, beard and moustache, enlargement of the scrotum and penis.

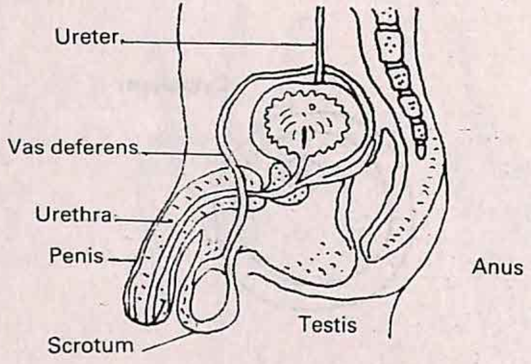


Fig. 9.3 Male reproductive organs.

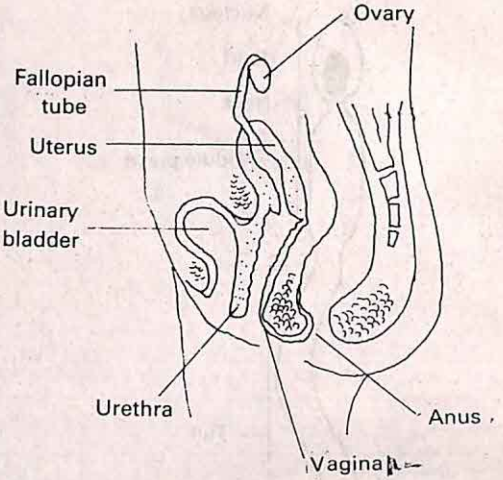


Fig. 9.4 Female reproductive tract.

Reproductive Organs in Males

As you already know, in males the testes are the reproductive organs, Fig. 9.3. These are paired structures placed in the muscular **scrotal** sac. The cavity of the scrotum is separated from the body by a muscular partition. A duct called **vas deferens** enters the body cavity from each testis and both the ducts (vas deferentia) open into a common duct known as the **urethra**.

The urethra opens to the exterior after passing through the **penis** (which is richly supplied with blood vessels). It is used for passing urine and ejecting sperms stored in the testes, into the female reproductive tract. A structure known as the **seminal vesicle** secretes a fluid, called semen, which nourishes the sperms in the vas deferens.

Reproductive Organs in Females

A pair of **ovaries, fallopian tubes** and **vagina** constitute the female reproductive system. The paired ovaries are situated in the abdominal cavity, Fig. 9.4. The muscular **fallopian tubes** are lined with cilia and transport the ova to the uterus. The thick walled **uterus** is formed by the joining of the fallopian tubes and the baby in mammals develops here. The uterus is situated posteriorly and narrows to form the muscular cervix which opens outwards through the vagina. The urine brought to the urinary bladder by the ureters is passed through a separate opening, the urethra.

On attaining sexual maturity, i.e., after puberty, the ovary produces an ovum every 28 days. This cycle of 28 days is characterised by a process in which mucous, uterine tissues along with blood is discharged and a new layer is formed. This discharge is repeated every 28 days and continues for 3-4 days, and is known as **menstruation**.

Around the 14th day from the start of menstruation, **ovulation** (release of the ovum) occurs. If the ovum does not meet a sperm cell, it starts degenerating and is discharged alongwith the uterine lining. If it happens to meet a sperm cell within 14th to 16th day, fusion occurs to form the zygote, Fig. 9.5.

The zygote attaches itself to the uterine lining through a special type of tissue called **placenta** which is richly supplied with blood. The zygote develops into an embryo with the help of the nourishment provided by the placenta. The embryo takes a period of 9 months to develop into the form in which it is expelled from the uterus.

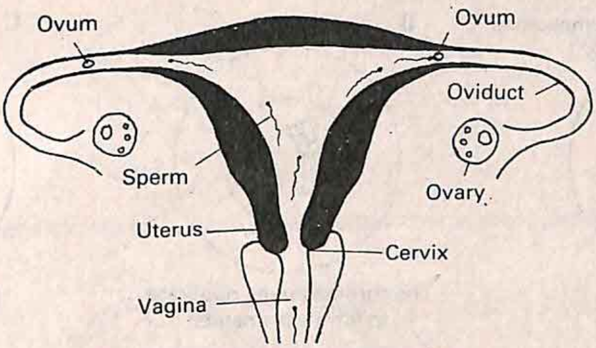


Fig. 9.5 Fertilization in human beings.

Once the embryo fixes itself to the uterine wall neither menstruation nor ovulation occurs. However these processes resume after child birth. The males are capable of producing sperms throughout their life but in females, menstruation ceases at 45-59 years of age. The ceasing of menstruation is known as **menopause** and the female is no longer capable of reproducing.

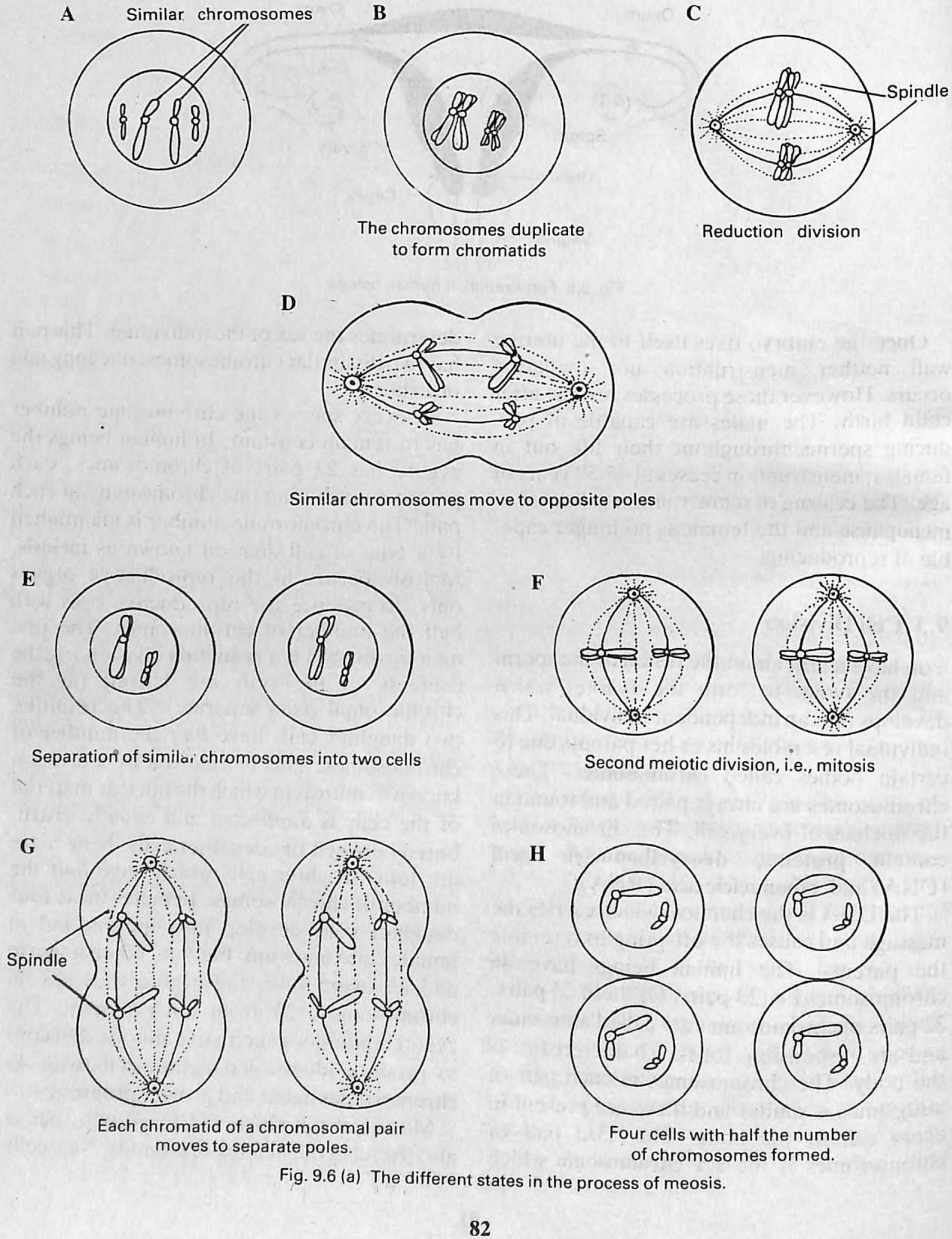
9.3 Cell Division

You have learnt about the fusion of the sperm and the ovum to form the zygote, which develops into an independent individual. This individual resembles his or her parents due to certain bodies called **chromosomes**. These chromosomes are always paired and found in the nucleus of every cell. The chromosomes contain proteins, **deoxyribonucleic acid** (DNA) and **ribonucleic acid** (RNA).

The DNA is the chemical which carries the message and causes the offspring to resemble the parents. The human beings have 46 chromosomes,i.e.,23 pairs. Of these 23 pairs, 22 pairs of chromosomes are called **autosomes** and are responsible for the characteristics of the body. The chromosomes in each pair of autosomes is similar and these are present in every cell of the body. The 23rd pair of chromosomes is the **sex chromosome** which determines the sex of the individual. This pair has two dissimilar chromosomes, one long and one short.

In every species the chromosome number has to remain constant. In human beings the zygote has 23 pairs of chromosomes, each parent contributing one chromosome in each pair. The chromosome number is maintained by a type of cell division known as **meiosis**. Meiosis occurs in the reproductive organs only, to produce the reproductive cells with half the number of chromosomes. The first meiotic division is a **reduction** division,i.e.,the contents of the cells are halved (as the chromosomal pairs separate). The resulting two daughter cells have *half* the number of chromosomes. This is followed by a division known as **mitosis** in which the nuclear material of the cells is *duplicated* and *equally* distrubuted between the daughter cells. Now there are four daughter cells which have *half* the number of chromosomes. In males these four daughter cells develop into sperms and in females into an ovum, Fig.9.6. When a sperm and an ovum fuse, the zygote thus has 46 chromosomes, 23 from each parent. The zygote undergoes successive mitotic divisions to produce identical daughter cells with 46 chromosomes each, and growth progresses.

Mitosis is not restricted to growth, but is also useful in the healing of wounds. New cells



The chromosomes duplicate to form chromatids

Reduction division

Similar chromosomes move to opposite poles

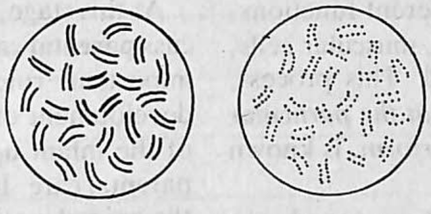
Separation of similar chromosomes into two cells

Second meiotic division, i.e., mitosis

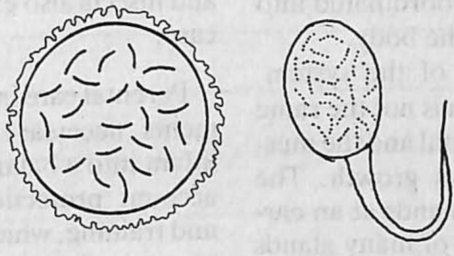
Each chromatid of a chromosomal pair moves to separate poles.

Four cells with half the number of chromosomes formed.

Fig. 9.6 (a) The different states in the process of meosis.



The body cells of women and men each contain 23 pairs of chromosomes.



At maturity, each reproductive cell has only 23 single chromosomes. Through meiosis, one member is taken randomly from each original pair of chromosomes

Zygote

Fig. 9.6 (b) Maintenance of chromosome numbers during meiosis.

are produced by this process to replace the injured or dead ones.

9.4 Growth and Development

Fertilisation is not the end of sexual reproduction; in fact it is the beginning of a series of well-organised, irreversible changes which eventually give rise to an adult. This *series of changes in the body, causing the increase in size and shape of the body is* known as **growth**. This is followed by an increase in weight and takes place as a result of the multiplication of the vast number of cells that make up an individual's body.

During growth, the zygote nucleus undergoes a series of mitotic divisions as mentioned earlier and more cells are formed (i.e., there is an increase in the amount of protoplasm in the body). In the early stages, growth takes place throughout the body, but in the later stages, it becomes localised.

The cells produced as a result of mitosis, get organised into layers in order to give the developing organs a definite shape. These cells gradually change and attain a particular form in order to perform different functions. New cells such as nerve cells, muscular cells, blood cells, etc., are formed. This process, *where cells are modified to suit the particular functions that they have to perform*, is known as **differentiation**.

The differentiated cells get organised into tissues which in turn, are organised into organs. The organs are then coordinated into the various organ systems of the body.

Even after the formation of the system, growth continues. The growth is not the same in all organ systems. The skeletal and the muscular systems show maximum growth. The growth of the nervous system ends at an earlier stage of life. The growth of many glands e.g., thymus ends before the individual becomes a youth. There is significant growth after puberty, in the reproductive systems.

In man maximum growth occurs in the first year of life. This growth gradually decreases upto 12 years of age. The individual is now in his adolescence. Growth is now accelerated with the coming of youth but gradually slows down again, with the advancement of years. The growth depends upon genetic factors, proper production of hormones in the body and availability of adequate amount of nutritive food.

An eloborate series of changes called **development** transforms the infant to adult (via adolescence), causes aging, and finally death. Thus the scope of the study of development of man includes the entire life span of an individual, right from the formation of gametes till the death of the individual.

At this stage, it would be worthwhile to discuss **parental care** because this factor plays an important role both in the growth and development of an individual. The nurturing of the infant upto a certain age is known as parental care. It is a phenomenon observed in the animal world only. It is present mainly in higher animals though certain fishes, molluscs and insects also exhibit some form of parental care.

Parental care includes all aspects of requirements necessary for proper growth of an infant into a balanced individual. It takes into account protection, supply of nourishment and training, which would assist the individual to survive best in the existing surroundings.

In mammals as the baby develops inside the mother's body, the nutrition is provided through the placenta, about which you already know. After birth, the mammary glands of the mother produce milk for nourishing the baby. Various members of the dog and cat families, besides providing the basic requirements, train the young ones to hunt for food.

In addition to the basic needs of the child, the human parents also provide emotional security as the child grows up. The parents teach him the moralities of life and provide him with a good education. The child is, in fact, taught everything which will equip him to face life in a better way. The guidance of the parents prepares the child to develop into an *individual*. Thus parental care extends over the longest period in human beings.

EXERCISES

1. What is the importance of reproduction? ____________________

2. Explain the following in a few lines.

(a) Binary fission

(b) Budding

(c) Regeneration

3. What are the changes occuring during puberty?

4. What are chromosomes and how are they responsible for the child resembling its parents?

5. Give the names and functions of the two types of chromosomes. ________

6. What is the significance of meiosis? ________

7. How does parental care equip the individual to face life in a better manner? ________

Fill in the blanks

(i) The testes produce ________ which are nourished by the fluid called ________ produced by the ________ ________.
(ii) Fallopian tubes join to form the ________.
(iii) ________ is a cycle of 28 days during which ovum is released by the process of ________.
(iv) ________ provides nourishment to the developing embryo.
(v) In ________ two daughter cells are produced with the same number of chromosomes.

10

The Muscular System

Locomotion is one of the most important functions of the body. It involves the alternate *contraction* and *relaxation* of the **muscles** which account for all body movements, Fig. 10.1. Muscles form the major bulk of the body. There are about 600 different muscles present in the human body, divided into three categories. Muscles are mostly seen as fibres varying widely from 1 mm to 30 cm.

10.1 Different Kinds of Muscles

Three different kinds of muscles are found in vertebrates. **Smooth** muscles are present in the walls of the hollow organs of the body. The walls of the intestines, the urinary bladder, blood vessels, and the wall of the uterus for example, are made up of smooth muscles. Contraction of these muscles reduces the size of these hollow organs, which leads to several activities within the body.

The contraction of smooth muscles in the stomach mixes the food with the digestive juices, and also causes the movement of food down the alimentary canal. In the urinary bladder, their contraction causes the expulsion of urine. The parting of the embryo from the uterus during birth is also due to the contraction of these muscles. Since we do not have any control over their movements, they are also called *involuntary* muscles.

Skeletal muscles are generally attached to the bones, e.g., biceps, triceps. They can be controlled wilfully and hence, are known as *voluntary* muscles. They have light and dark bands in their cytoplasm which make them appear *striped* or *striated*. It is due to the movement of these muscles that all voluntary actions, such as running, swimming, playing instruments and working with tools, etc., are possible.

The **cardiac** muscles make up the wall of the heart. It is not under our control, that is, it is *involuntary* in function. This muscle also has light and dark bands in the cytoplasm. The cardiac muscles are branched so that their contractions can spread to all the fibres throughout the heart. These muscles can work tyrelessly for a very long time.

Muscular activity requires a large amount of energy which the body obtains by consuming energy-rich food. The food gets oxidised and

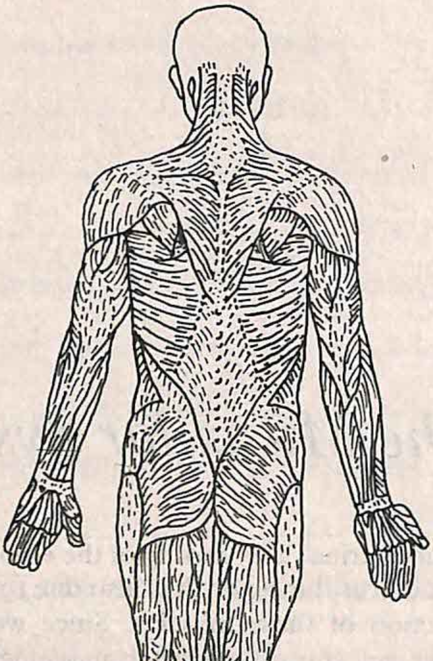


Fig. 10.1 Muscles in our body.

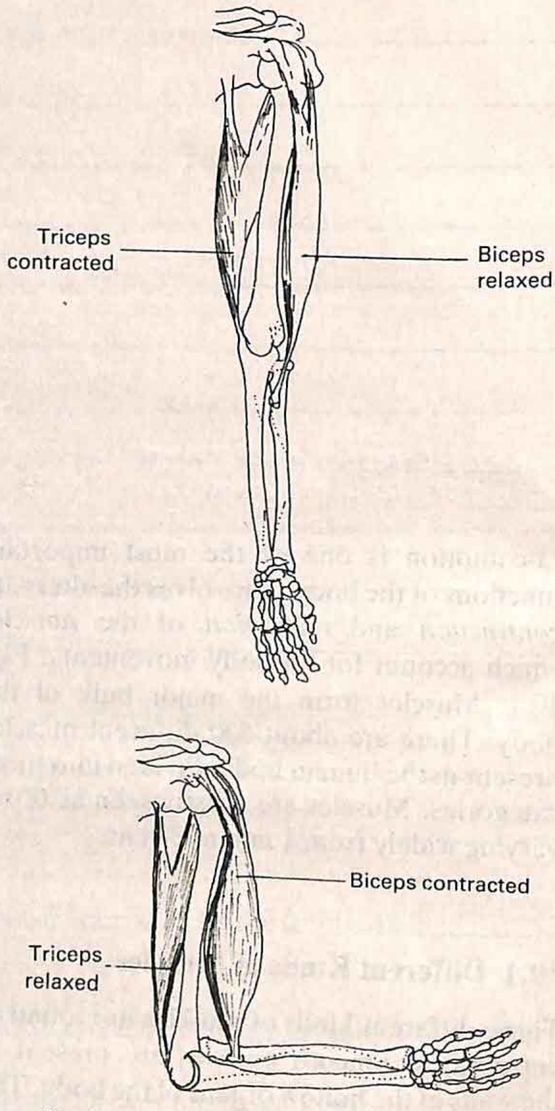


Fig. 10.2 Upper arm muscles of the human body.

the energy thus produced is used for muscular movements. The heat evolved as a result of muscular contraction is not wasted; it serves in warming up the blood. Also when we shiver in cold weather, the muscular movement that follows, produces more heat to maintain body temperature.

Muscles perform a large variety of movements. In order to bend the elbow, the **biceps** in front of the arm contract and the **triceps** at the back of the arm straighten, Fig. 10.2. Different parts of the body are brought closer by the **flexor** muscles, whereas the **extensors** move them apart. **Abductor** muscles move the limbs away from the rest of the body and **adductors** move them back. Further, there are **rotator** muscles at the shoulder and at the hip joints. Circular muscles, called **sphincters** help in closing the mouth. Certain muscles can perform more than one function.

10.2 Muscular Disorders

Muscles near joints are sometimes prone to **sprains**. Sprains occur when the joints are overstrained or the muscles are overstretched. **Cramps** which occur in the muscles of the foot and legs are due to prolonged painful contraction of these muscles. Excessive use or too much strain on the muscle may also cause stiffness and pain.

Any muscle contraction is normally initiated by motor nerves. Any damage to the nerve cells or its axon results in the **paralysis** of the muscle. In **poliomyelitis**, muscle weakness is induced by the **polio virus**, which infects the nerve controlling the muscle. This can be prevented by vaccinating the child, with polio vaccine.

EXERCISES

1. Why are the striped, voluntary muscles called skeletal muscles? ____________

____

____

____

2. What is the difference between voluntary and involuntary muscles of our body? Give an example of each. ____

____

____

3. (a) Where are smooth muscles present? ____

____

____

(b) What are the different functions of these muscles? ____

____

____

____

____

4. Why are cardiac muscles branched?

5. Match the following:

(a) Poliomyelitis	(1) generally attached to bones.
(b) Cardiac muscles	(2) occur due to prolonged contraction.
(c) Skeletal muscles	(3) are involuntary in function.
(d) Cramps	(4) caused by polio virus.

6. State true or false.
   (1) Different parts of the body are brought closer by abductor muscles.
   (2) Circular muscles help in the closing of the mouth.
   (3) Muscles are responsible for the movements in our body.
   (4) Cardiac muscles in the urinary bladder contract to expel urine.
   (5) Skeletal muscles help in running, swimming, playing etc.

11

Skeletal System

The skeleton forms the framework of our body. This framework gives support to our body, protects the vital organs and provides a place for the attachment of the muscles. The human skeleton is composed of 206 bones of different shapes and sizes, Fig. 11.1. Bones are living tissues like any other tissues of our body. These bones are hard due to the presence of mineral matter, mainly calcium phosphate.

The skeleton serves as a store-house for calcium and phosphorus. When there is a deficiency of these minerals in our body it may be obtained from the skeleton. Bones also contain a gelatinous substance called **collagen**.

The outer surface of all bones is made up of a white substance called the compact bone. It has a large number of canals called **haversian canals** which provide a passage for blood vessels and nerve fibres. Long bones possess a long shaft of compact bone with a hollow cavity filled with a fatty tissue. This substance is called the **bone marrow** and is the site for manufacture of red blood cells, Fig. 11.2.

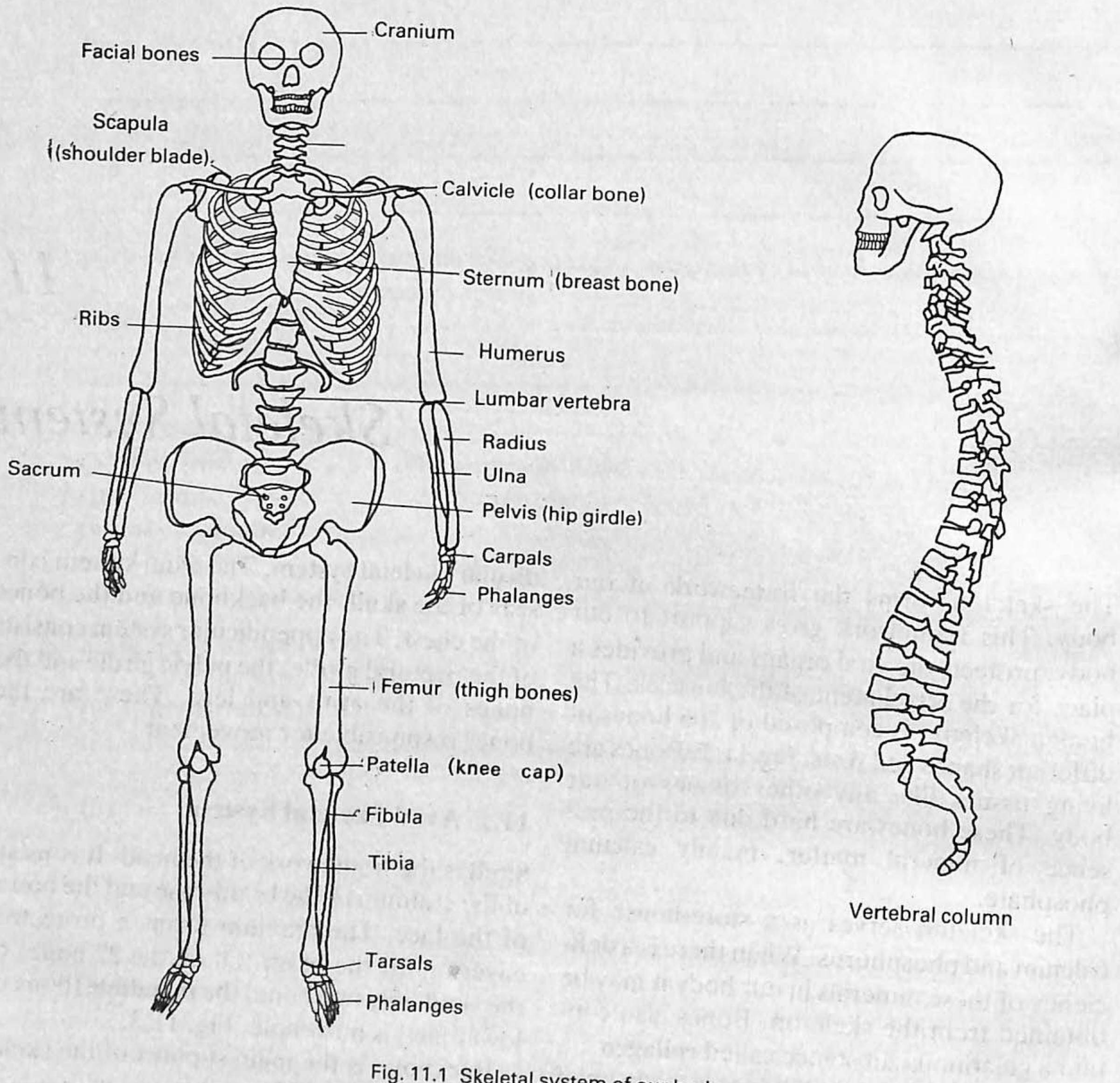
Skeletal system can be divided into two categories, **axial skeletal system** and **appendicular skeletal system**. The axial system consists of the skull, the backbone and the bones of the chest. The appendicular system consists of the pectoral girdle, the pelvic girdle and the bones of the arms and legs. These are the bones responsible for movement.

11.1 Axial Skeletal System

Skull is the framework of the head. It consists of the cranium or the brain-case and the bones of the face. The cranium forms a protective covering for the brain. Of all the 22 bones of the skull only one bone, the **mandible** (bone of lower jaw) is moveable, Fig. 11.3.

Backbone is the main support of the skeleton. It is made of 33 small bones with a hole running through each of them, Fig. 11.1. We call each of these a **vertebra** (plural vertebrae). These vertebrae are joined to each other forming a continuous canal through which the spinal cord passes. The backbone protects the spinal cord and provides an attachment for the ribs and the hip bones and helps in maintaining an erect posture.

Ribs are semi-circular bones forming a pro-



Vertebral column

Fig. 11.1 Skeletal system of our body.

tective cage around the heart and lungs, Fig. 11.4. There are 12 pairs of ribs. The first 7 pairs are attached to the vertebrae at the back and to the breast bone or **sternum** in front. The next three pairs of ribs are attached to the backbone at the back and in front they are attached to the seventh pair. The remaining two pairs are only attached to the back bone and are otherwise free and are hence called the **floating ribs**.

11.2 Appendicular Skeletal System

As we have mentioned earlier, this system consists of the two pairs of **girdles** and bones of arms and legs, as in Fig. 11.1.

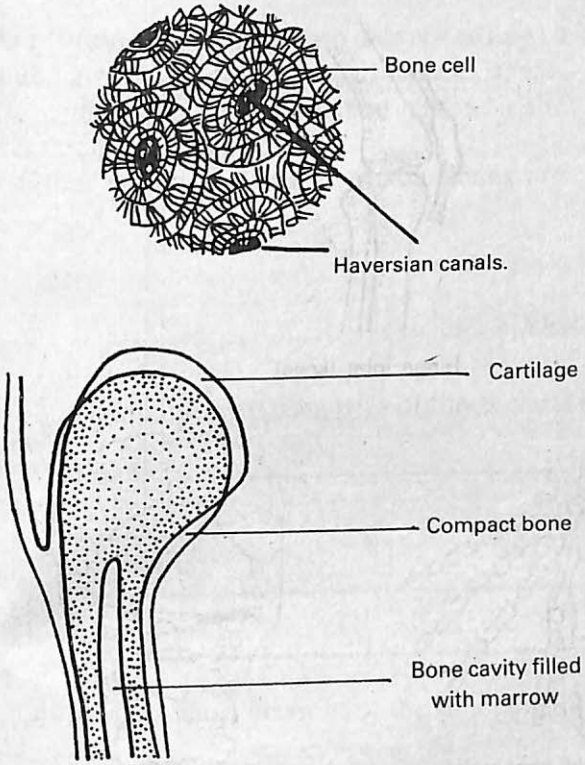


Fig. 11.2 Structure of bone

Girdles are attached to the axial skeletal system and give support to the bones of the limbs. The **pectoral girdle**, which supports the arms consists of the collar bone (**clavicle**) and the shoulder blade (**scapula**).

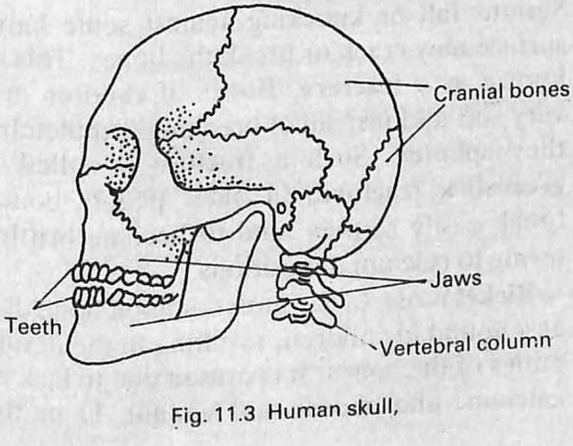


Fig. 11.3 Human skull,

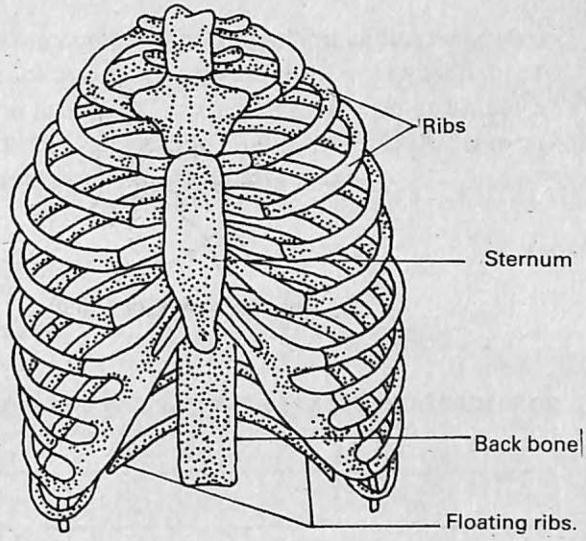


Fig. 11.4 The rib-cage.

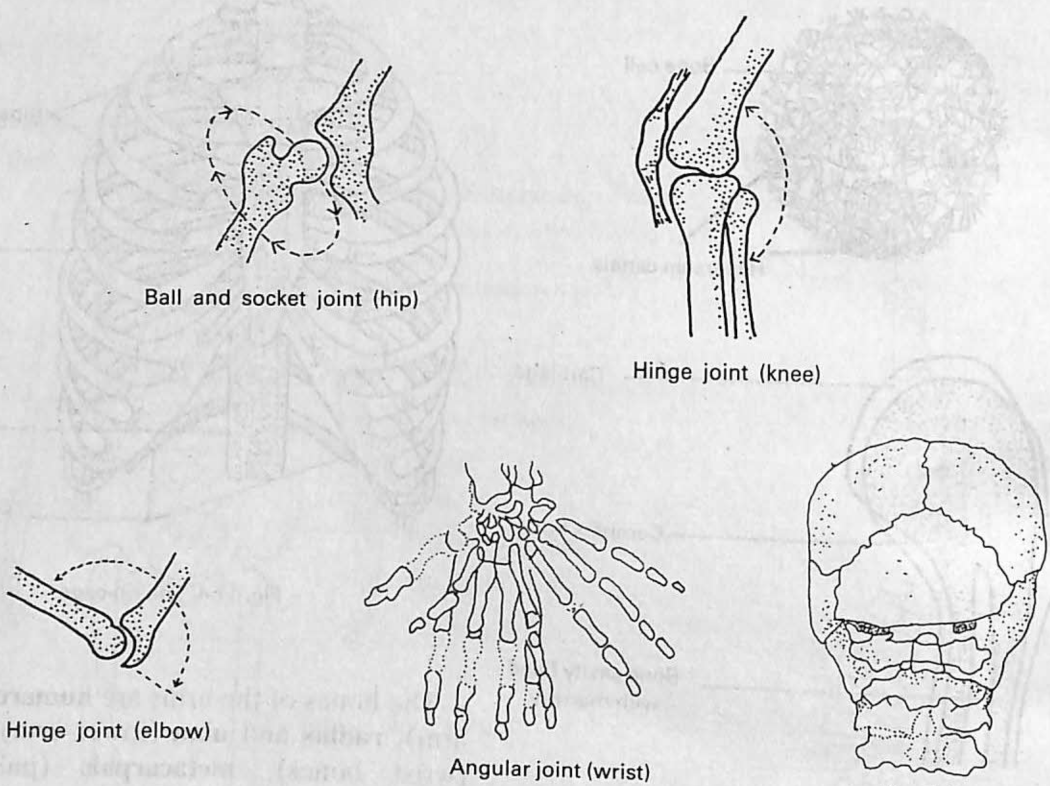
The bones of the arms are **humerus** (upper arm), **radius** and **ulna** (lower arm), **carpals** (wrist bones), **metacarpals** (palm) and **phalanges** (digits).

The bones of the legs are fitted to the **pelvic girdle** which is joined rigidly to the spine, Fig. 11.1. This girdle consists of three bones namely **ilium**, **ischium** and **pubis**. Bones of the legs are **femur** (thigh bone), **tibia** and **fibula** (bones of the shank), **tarsals** (ankle bones), **metatarsals** (foot) and **phalanges** (toes).

11.3 Kinds of Joints

We use our hands, fingers, arms and legs for doing various kinds of work. Each is involved in different movements made possible because of various joints, as shown in Fig. 11.5. We can move our elbows and knees in one direction only. This type of joints are called **hinge joints**.

The femur and humerus bones of the legs and arms have ball shaped heads which are fit-



Ball and socket joint (hip)

Hinge joint (knee)

Hinge joint (elbow)

Angular joint (wrist)

Pivot joint

Fig. 11.5 Kinds of joints in our body.

ted into the hollow cavities present in the pelvic and pectoral girdles respectively. This joint is called the **ball and socket joint** and allows circular movements.

We can move our head up and down and also sideways. All these movements are possible because of the nature of the joint between the skull and vertebrae. There is a hole in the first vertebra which forms a ring. The skull rests on this ring. The second vertabra has a projection that fits into this ring. This joint is known as the **pivot joint**.

The wrists or the ankles can be moved in two directions, i.e., they can be moved up and down. Such a joint is called the **angular joint**. Thus we see that different joints are devised to suit their specific functions.

11.4 Fractures and Diseases of Bones

Serious fall or knocking against some hard surface may crack or break the bones. This is known as a **fracture**. Bones of children are very soft and instead of breaking completely, they splinter. Such a fracture is called a **greenstick fracture**. In older people bones break easily as they tend to become brittle, owing to calcium depositions.

Ricket is one of the most common bone disease found in children, resulting in the deformities of the bones. It is caused due to lack of calcium, phosphorus and vitamin D in the diet. Providing an adequate diet consisting of milk, green vegetables, eggs, cheese, meat, etc., and ample sunshine to the patient is the treatment for this disease.

Other common diseases of the bones are **osteomyelitis** (inflammation of the bone marrow) and tuberculosis. Both are caused due to the infection by a particular type of bacteria. These diseases are completely curable if treatment is given at an early stage.

EXERCISES

1. Name the two categories of the skeletal system and give the names of the bones forming them.

4. Write a short account of the functions of the skeleton.

2. How is the backbone designed to protect the spinal cord?

3. Name the bones of the arms and the legs.

5. What is the difference between hinge joints and angular joints?__________

6. How does pivot joint help in the movement of our head?__________

7. Fill in the blanks.
   (1) Ball and socket joint is found in the __________ and __________.
   (2) __________ form a protective cage around the heart and the lungs.
   (3) When the bones in children splinter it is known as __________ __________.
   (4) Bone deformities are caused due to a disease known as __________.
   (5) __________ causes inflammation of bone marrow.
   (6) A gelatinous substance called __________ is found in the bones.
   (7) The compact bone has a large number of __________ __________ which provide passages for blood vessels and __________ __________.

12

Heredity, Variation and Evolution

Have you ever wondered why living organisms resemble their parents? You have already studied about the various types of reproduction shown by living organisms. As a result of reproduction, whether sexual or asexual, a new generation of organisms, resembling their parents is formed. The chemical instructions present in the fertilised human egg control the development of the embryo into an adult human being, rather than into a cat or a mouse. The process is the same in the case of all plants and animals.

12.1 Heredity

The *chemical* instructions which the reproductive cells receive from the parents are responsible for the **heredity** of the new individual, i.e., heredity *is the tendency of organisms to resemble their parents*. These chemical instructions are stored in tiny particles arranged on **chromosomes** about which you have already studied. Such individual particles are called **genes**, which are the bearers of heredity.

The genes are a small portion of a molecule called **DNA** (deoxyribonucleic acid). Each pair of genes controls one individual character of the organism with the help of another chemical, called **RNA** or ribonucleic acid. Gene action could be understood only after the discovery of the molecular structure of DNA. Watson and Crick constructed a model of the structure of DNA and won the Noble Prize in 1962.

What an organism becomes is totally dependent upon the interaction between its *heredity* and the *environment*. What an organism *may become* is determined by heredity but what it *actually becomes* depends on both heredity and environment. Every organism has a specific gene pattern known as the **genotype**. The genotype interacts with the environment to produce a definite kind of an organism. The physical expression of the genotype, after interaction with the environment is known as the **phenotype** of the organism.

12.2 Variation

There is always a basic plan which makes all members of a species look alike. But we know that no two organisms of the same species are exactly alike. Offsprings resemble their parents, but at the same time, they differ from them too. These differences that occur between the members of the same species are known as **variations.** In other words, variation is the tendency of the offspring to differ from parents.

Gregor Mendel, in 1865, experimented with garden peas and threw light on the nature of heredity and variation. He wanted to find out about the transmission of characters from one generation to the next. There are some pea plants which grow tall and there are others that are dwarf Seeds of some tall and dwarf plants produce tall and dwarf plants, respectively, for all generations to come, Fig. 12.1. When this happens, the plants are considered as either **pure** tall or **pure** dwarf. But if the tall plants give rise to both tall and dwarf plants in the next generation, the parent plants are called **hybrids.**

If cross fertilization takes place between two hybrid pea plants they produce hybrid and pure plants in the ratio 1:1, as seen in Fig. 12.2. Mendel also cross fertilized a tall pea plant with a dwarf one. All the seeds developed into tall plants. When these tall plants were crossed they produced tall and dwarf plants in the ratio 3:1, Fig. 12.2. He raised a second generation from these three tall plants and found that only one tall plant was pure breeding and the other two were hybrids. You have already seen that when hybrids are crossed they produce two pure plants and two hybrids (1:1).

Mendel repeated these experiments taking into account other factors such as the colour and shape of seeds, etc. He found that when individuals with two different characters are crossed, only one character is expressed in the next generation and the other character remains hidden. For example, when a tall plant is crossed with a dwarf, in the next generation all plants are tall. This character that is *expressed* is called **dominant** and the one that is *supressed* is called **recessive.**

The pure plants thus have either a dominant character (tallness) or a recessive character (dwarfness). In the hybrid, only the dominant character is expressed. All these findings of Mendel came to be known as Mendel's laws of heredity. These laws help us to understand the transmission of characters from one generation to the other.

Even before Mendel, mankind made use of techniques of selective breeding to improve agricultural crops and domestic animals. The knowledge of genetics helped in the improvement of these techniques. Now another new area of study known as **genetic engineering**, aims at improving the quality of all living organisms. This may be achieved by correcting the wrong genes which are responsible for genetic abnormalities.

Certain abnormalities or diseases are observed in human beings due to wrong genes or abnormal chromosomes. Colour blindness, i.e., failure to recognise red or green colour and haemophilia—a disease in which blood loses the property of clotting, are two common genetic disorders in man.

Evolution

Variation is an indispensable tool for evolution. The theory of Evolution by Natural Selection was put forward by Charles Darwin in 1859. He observed that living things change, that is, some species may die and others may arise. This means that the present physical forms of plants and animals that we see on the surface of the earth are not the same as the original plants and animals.

The complex forms of life that we come across now are derived from relatively simpler

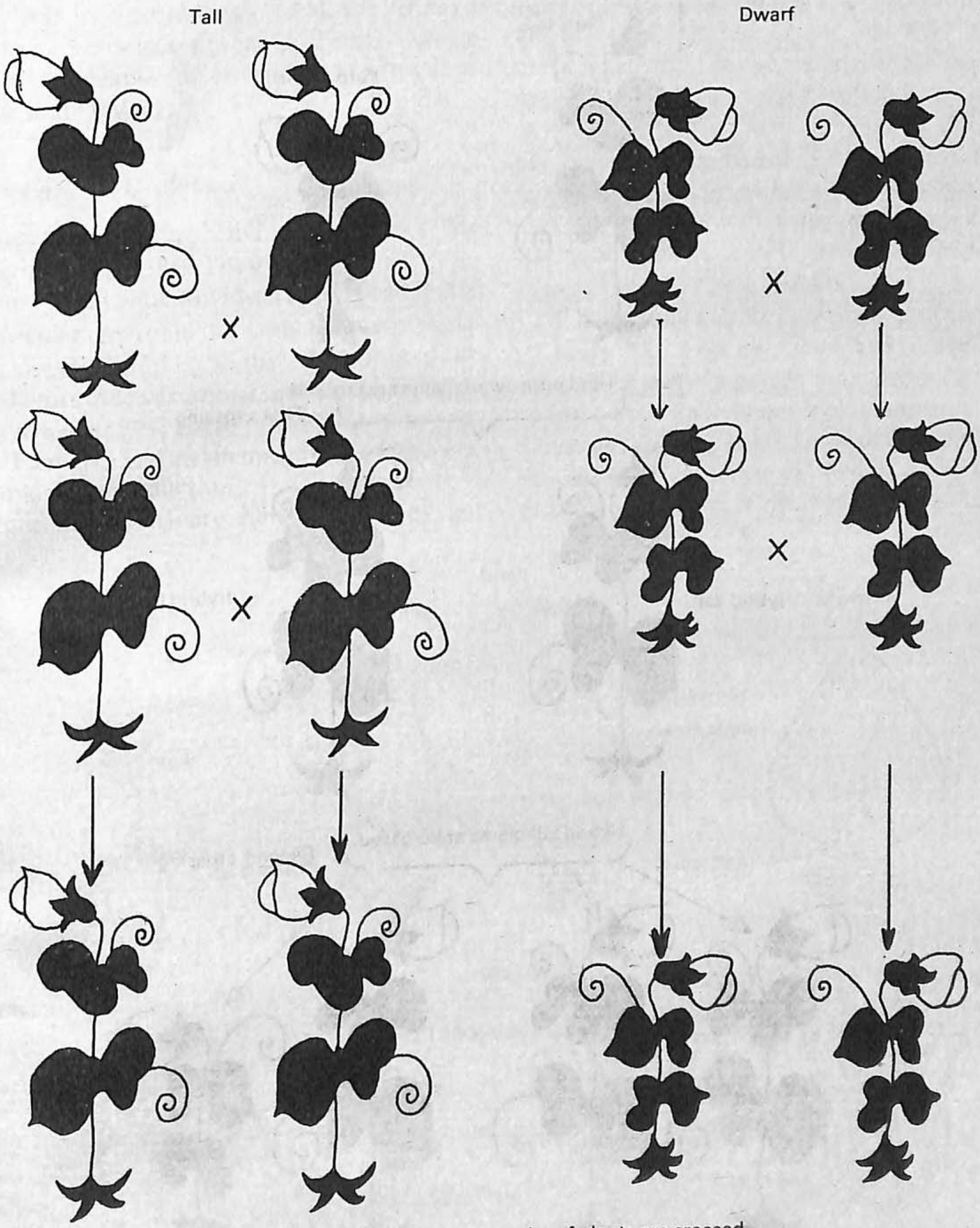


Fig. 12.1 Two pure tall and pure dwarf plants are crossed.

forms. Life originated as a simple speck of substance and all other subsequent forms have originated from that simple speck. This mechanism of organic **evolution** from simple to complex forms in order to adapt to the changing environment was explained in diffe-

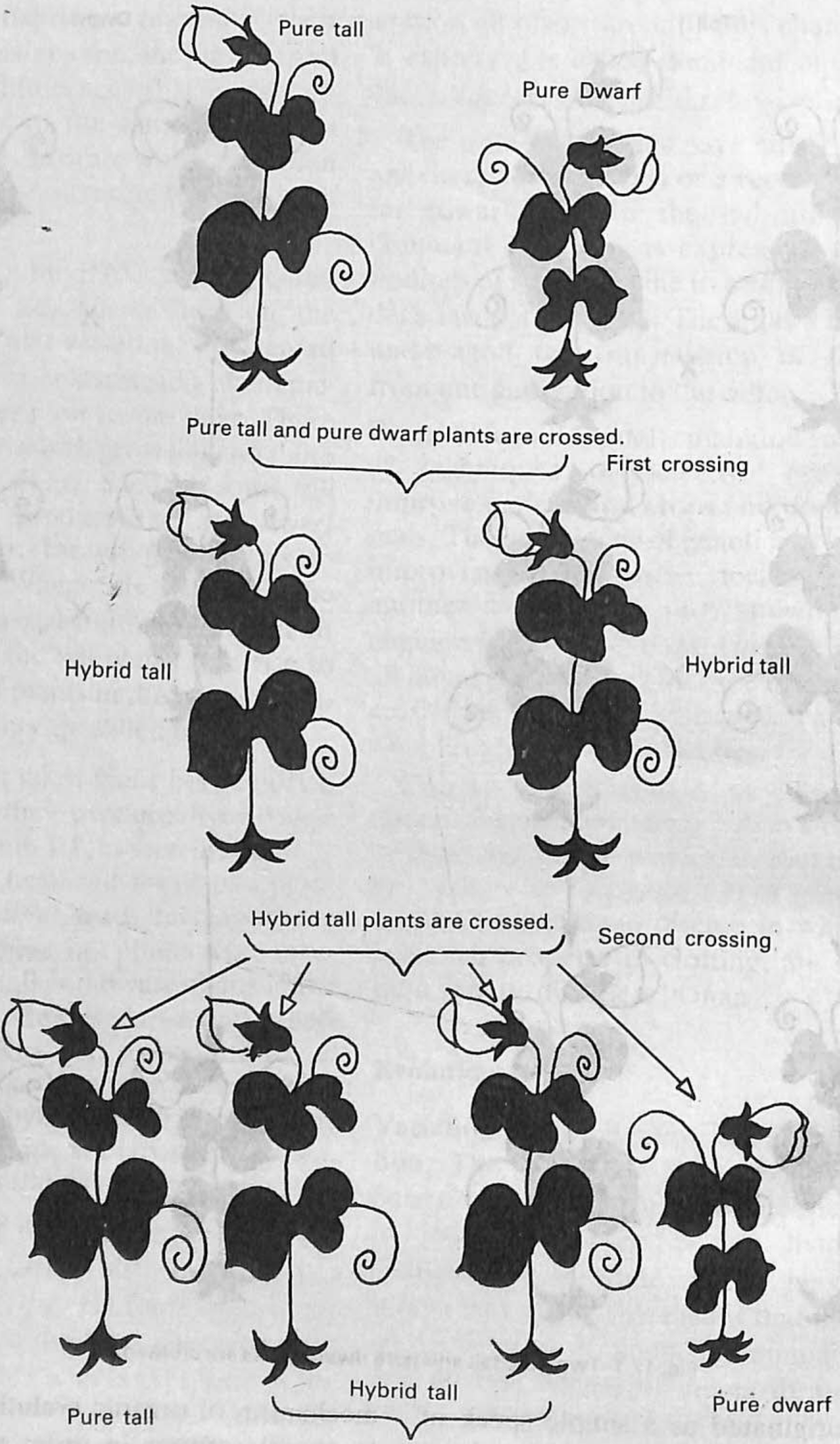


Fig. 12.2 (a) Pure and hybrid plants are in the ratio 1:1.
(b) Tall and dwarf plants are in the ratio 3:1.

rent ways by different scientists. Of all these theories, Darwin's theory has been widely accepted because of strong supporting evidence in its favour.

Mechanism of Evolution

Along with Nature, living organisms are changing constantly. These changes, i.e., variations, enable an individual to adapt better to a particular environment. Only the useful variations are favoured by Nature. The individuals with favourable variations survive the **struggle for existence**, i.e., there is **survival of the fittest**. They live and attain maturity and become capable of reproduction.

Since variations are hereditary, they get passed onto the offspring. The individuals with unfavourable variations are not able to survive the struggle for existence and hence they die before they can attain maturity or the age of reproduction. Thus, favourable variants are preserved by Nature (Natural Selection) until further changes take place in the environment. When variations accumulate over the generations, a new species comes into being (origin of new species).

Now, we have evidences from various fields of study like geology, geography, anatomy, morphology, physiology and embryology to support Darwin's theory of evolution.

Let us consider the evolution of the vertebrate heart as an example. Fishes have a two-chambered heart while amphibians have a

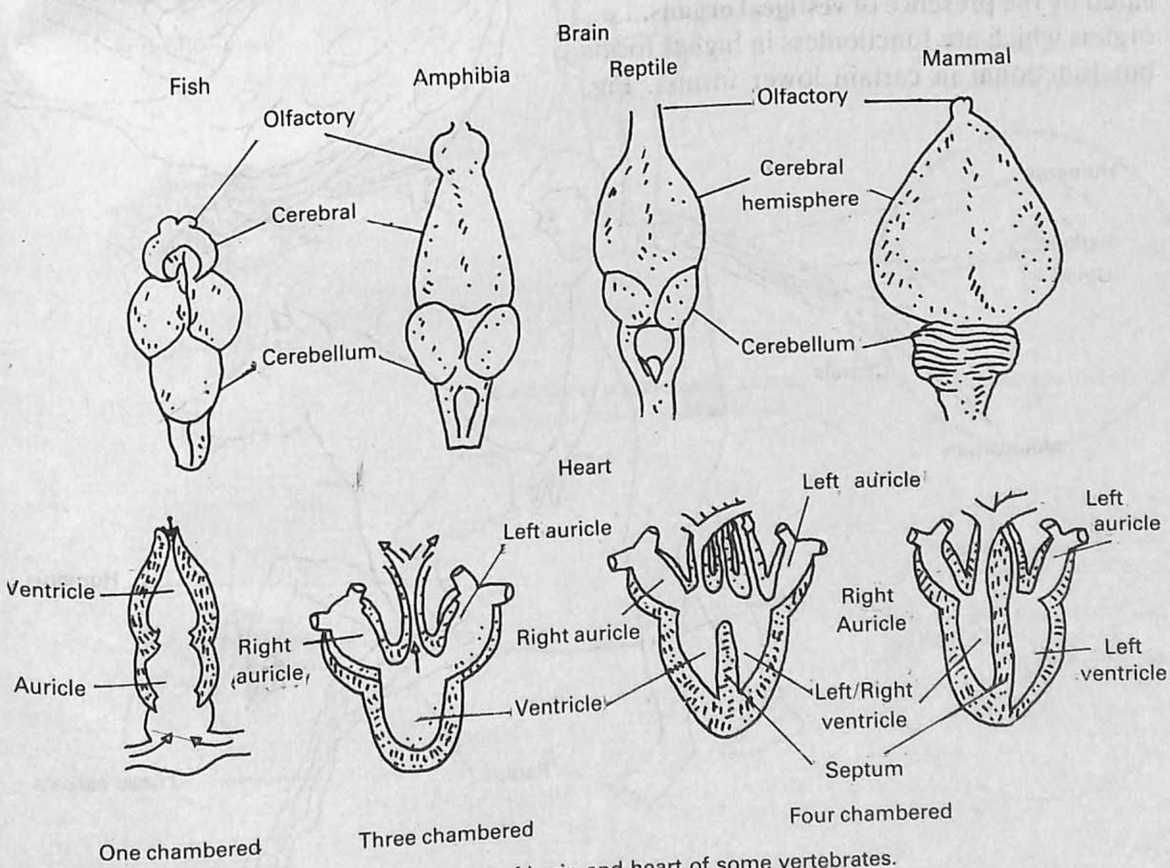


Fig. 12.3 Comparison of brain and heart of some vertebrates.

three-chambered heart as shown in Fig. 12.3. In birds and mammals, the heart has four chambers. The same type of complexity is observed in the comparative study of the brains of these vertebrates. Such a study of these organs illustrates an increasing complexity attained through evolution.

A comparison of the forelimbs of a man, a horse and a bird shows that they perform different functions but have the same skeletal arrangement. Such structures with similar origin but different functions are called **homologous organs**, Fig. 12.4. The presence of such homologous organs in different types of animals shows that all of them have originated from a common ancestor.

A similar type of ancestral origin is indicated by the presence of **vestigeal organs,** i.e., organs which are functionless in higher forms but functional in certain lower forms . Fig. 12.5 gives a list of such organs which are vestigial in man but functional in other animals.

In addition, further evidence is available from a study of the earth's crust. The surface of the earth is constantly changing as new layers are added at the top. These layers are deposited as rocks called **sedimentary rocks**. Geologists have special techniques to calculate the age of these rocks. In these rocks,

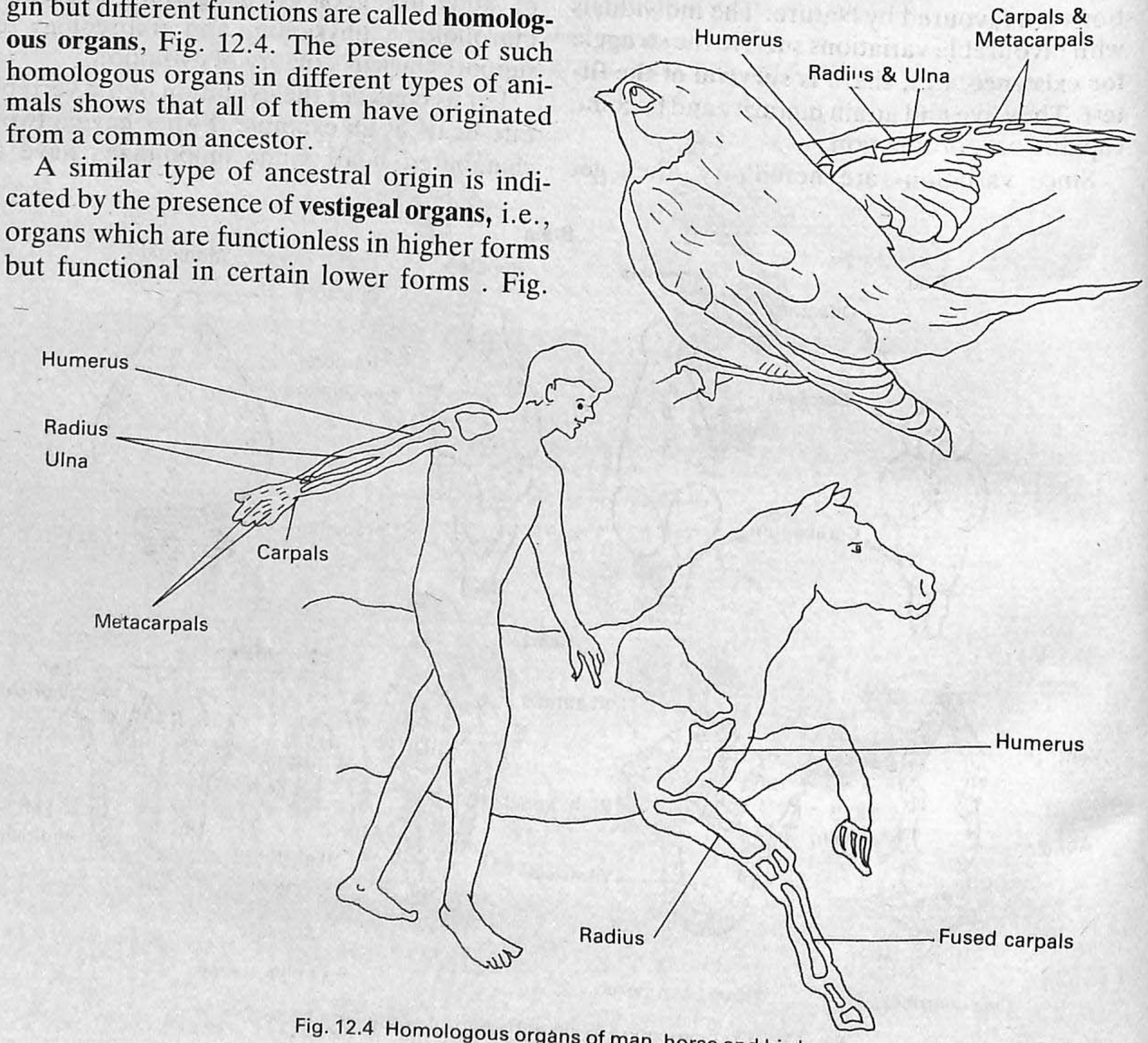
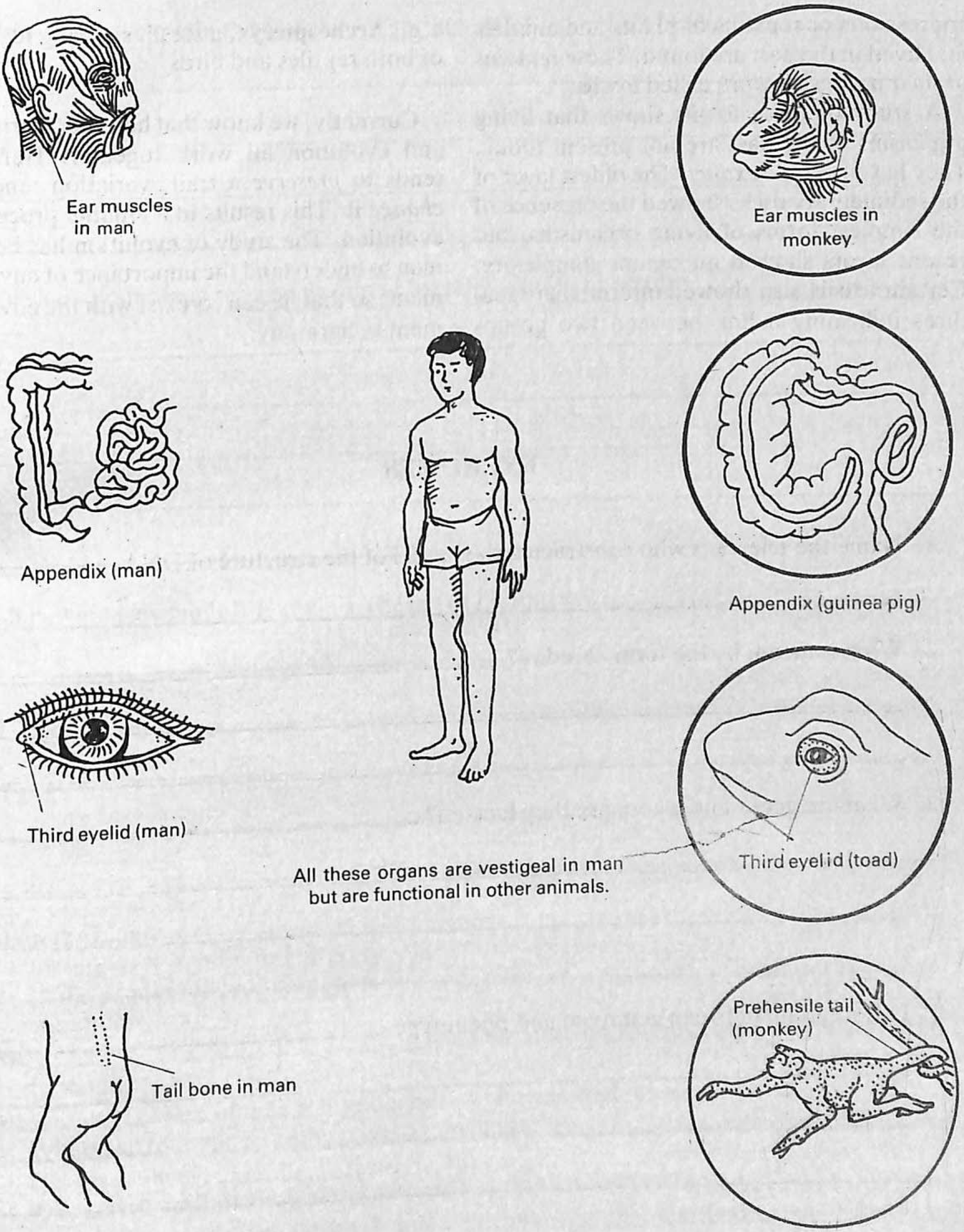


Fig. 12.4 Homologous organs of man, horse and bird.



All these organs are vestigeal in man but are functional in other animals.

Fig. 12.5 Edivences in favour of common ancestral origin.

impressions or remains of plants and animals that lived in the past are found. These *remains or their impressions* are called **fossils**.

A study of these fossils shows that living organisms of the past are not present today. They have become *extinct*. The oldest layer of the sedimentary rocks showed the presence of the simplest forms of living organisms, but recent layers showed maximum complexity. Certain fossils also showed intermediate features indicating a link between two groups e.g., **Archeopteryx**, a fossil, showing features of both reptiles and birds.

Currently, we know that heredity, variation and evolution all work together. Heredity tends to *preserve* a trait, variation tends to *change* it. This results in a *gradual* process of evolution. The study of evolution has helped man to understand the importance of environment, so that he can co-exist with the environment in harmony.

EXERCISES

1. Name the scientists who constructed the model of the structure of DNA. ____________

   ____

2. What is meant by the term heredity? ____________________________

   ____

   ____

3. What are genes and where are they located? ______________________

   ____

   ____

   ____

4. Differentiate between genotype and phenotype. ____________________

   ____

   ____

   ____

   ____

   ____

5. How can you explain the fact that offsprings differ from their parents? ________

6. Give a diagrammatic representation of Mendel's laws of heredity. ________

7. What evidences support Darwin's Theory of Evolution? ________

8. Fill in the blanks.
   (1) Failure to recognise red or green colour is known as ________.
   (2) In the process of evolution there is struggle for ________ which leads to survival of the ________.
   (3) ________ are structures with similar origin but different functions.
   (4) ________ of man is homologous to the wings of birds.
   (5) When two individuals with two different characters are crossed the expressed characters are called ________ while the ________ ones are called recessive.
   (6) If seeds of a tall plant produce only tall plants it is said to be a ________ tall plant but if it produces both tall and dwarf plants in the next generation it is said to be a ________.
   (7) Living organisms of the past which are not present today have become ________.

13

Useful and Harmful Animals

Man has to live in harmony with his surroundings. He is helped by several animals and plants around him and in turn, he must understand and fulfil their requirements. As there are animals which come to his help in times of need, there are others which cause great harm. It is thus very essential for man to differentiate between useful and harmful animals. In this chapter we will study about various animals, some which are friends of man and also about those that cause him harm.

Useful Animals

Animals are beneficial to us in several ways. They play a significant role in the welfare of mankind. We keep certain animals not only as pets but also to serve some specific purposes, e.g., hens for eggs and cows for milk, etc. This *keeping of animals for specific use* is known as **domestication**. Domesticated animals have special qualities of working, for the use of man. These animals have to be looked after and cared for, just as a human being. They have to be provided food, shelter and protection against diseases.

The camel is known as the 'ship of the desert' and serves the people living in sandy areas in several ways. It acts as a mode of conveyance, provides them milk and its hide is used to make leather. All around us we see horses transporting people and loads from one place to another. Sheep and goat are reared in hilly areas for their wool and milk, respectively. Such animals which are *kept or raised for use on the farm and for house-hold work* are known as **livestock**. The study of all the aspects of rearing the livestock is collectively known as **animal husbandry.**

In the rearing of animals, four factors have to be considered. They are :

1. *Selective breeding*: We want the animals for their specific characters and if we can improve upon them, it would prove all the more beneficial. The controlled multiplication of animals to maintain or improve their qualities is known as **selective breeding**. Man has been able to produce many breeds of different animals which meet his requirements.

2. *Regular feeding*: Food is essential for all living beings. The type of food (known as **feed**), the manner in which the feed has to be

given and the intervals between the feeds are factors to be taken into account. These factors vary from animal to animal.

3. *Timely weeding*: When some animals of the livestock develop certain undesirable qualities they have to be eliminated in order to prevent the spreading of these qualities to the other animals and the next generations. Also it is uneconomical to house and feed these animals. This elimination is known as **weeding**.

4. *Caring*: Care must be taken to maintain the health of the livestock. Like all other living organisms, they are prone to diseases. Specialists called **veterinary** surgeons, should perform regular check-ups, of the animals. This helps not only in preventing diseases but also in maintaining and propagating healthy breeds. Let us now study about these aspects of animal husbandry in some detail.

13.1 Cattle

This group includes cows, bullocks and buffaloes. These animals have been domesticated since time immemorial by our ancestors for agricultural and livestock purposes. Cows and buffalloes provide us with milk which is a rich source of protein. Many a Indian farmer, to this day depends on his bullocks for ploughing the fields as he cannot afford a tractor. The dung of the cattle is used as manure and also for producing gobar gas. Cattle hides are nowadays used for preparing leather goods which earn a lot of foreign exchange for the country.

Cattle are categorised on the basis of their utility into the following groups.

a) *dairy* breeds: useful for their high yield of milk.

b) *draught* breeds: domesticated for agricultural purposes.

c) *dual purpose* breeds: females are good milk producers while the males perform heavy-duty work.

In India though the population of cattle is large, due to nutritional deficiencies, the quality of work and the amount of milk produced are poor. In order to produce good breeds of cattle, we have to make use of selective breeding methods. Presently, we have developed several good breeds of bullocks and cows, for example, *Amrithmahal, Ongole, Kangayam* and *Red sindhi*. Some important breeds of buffaloes are *Murrah*, *Nagpuri* and *Surti*.

Taking Care of Cattle

While caring for the cattle we have to provide them with food and shelter. For this purpose we must know their food habits. These animals are herbivorous. A balanced diet must be given so as to obtain a good quality and quantity of milk and also work. Their food consists of *roughages* and *concentrates*; roughages are obtained from hay and fodder and concentrates from grains, bran, cotton seed-cakes, etc.

Ordinary grass mixed with alfalfa, (a type of legume) and clover (a proteinaceous legume) is the best food for these animals. These animals also require large quantities of water. Fixed timings and regular intervals must be maintained for feeding these animals. More attention is required for the well-being of the weaker animals.

The cattle have to be protected from the heat during summer and chill during the winter. They have to be provided with sheds which are well maintained, Fig. 13.1. The sheds should be erected away from human habitations to maintain sanitary conditions, but near the water supply in order to clean the animals regularly. The construction of the sheds must be such that they are airy, properly ventilated, and there is no scope for the animals to hurt themselves. Wheat straw or paddy straw is generally used to make beddings for the animals. Such a bedding is

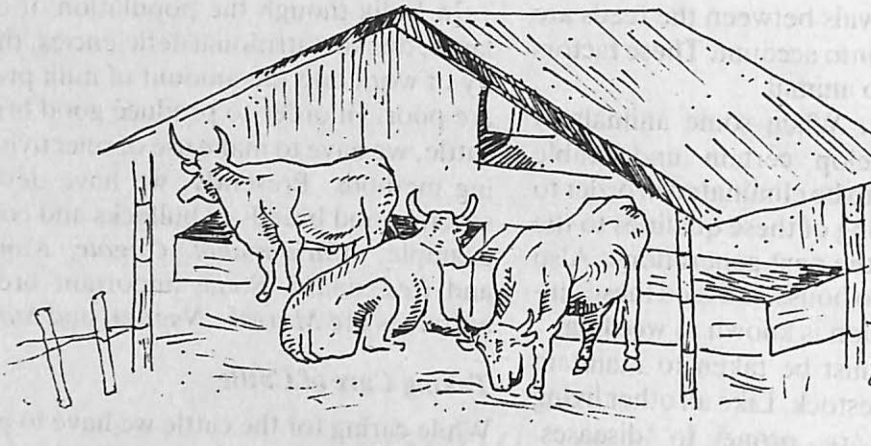


Fig. 13.1 Cows in their shed.

hygeinic and economical as it can absorb urine and can be later used as manure. The animals must be washed regularly to keep them clean and free from infections.

Milking is also an aspect of cattle-care. Cows and buffaloes are generally milked twice a day, morning and evening. Milking is done by hand by most Indian farmers (Fig. 13.2), or by machines in dairy farms. The udders must be washed before milking. Death of the calf may cause the cow to stop giving milk. Under such circumstances the cow may have to be consoled with a stuffed dummy of a calf. Any chemical stimulation before milking must be avoided, as it is harmful from the milking point of view.

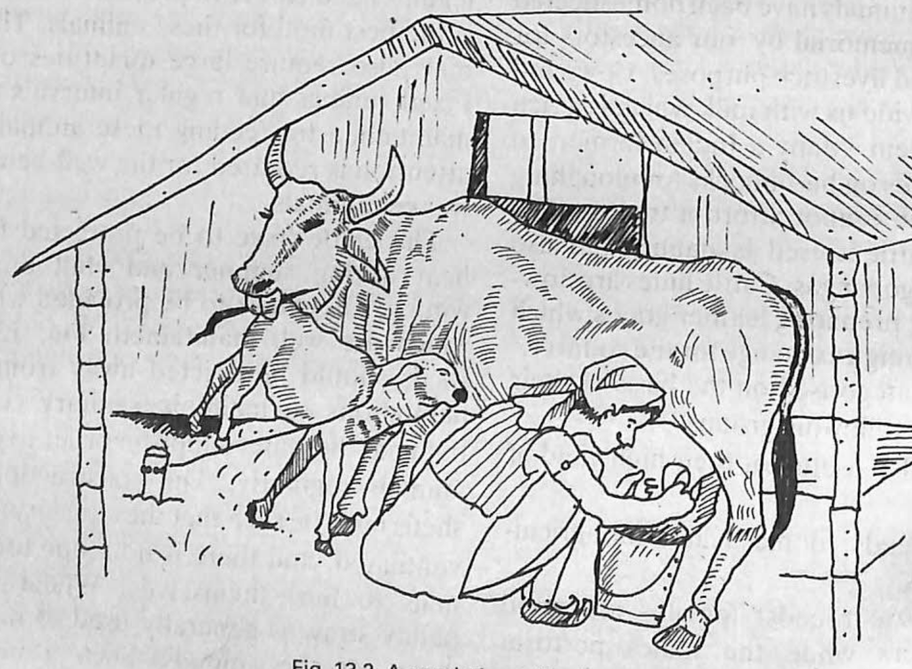


Fig. 13.2 A cow being milked by hand.

Like human beings, these animals also tend to fall sick. Some parasites known as **ectoparasites** are found on the skin and hair of these animals, e.g., lice and ticks. The leech is another such parasite which sucks the blood of cattle, while they are grazing. Different kinds of worms are found in the alimentary canal of the cattle (**endoparasite**).

The animals should be taken for regular check-ups to the **veterinary surgeon**, a person treating the diseases and injuries of the domestic animals . The veterinary surgeon **diagnoses** (identifies) the disease on the basis of the symptoms shown by the animals. The symptoms generally shown are: loss of appetite; reddening of the eyes; low production of milk; drooping ears and lips.

The cattle commonly suffer from foot and mouth disease which can be transferred from one animal to the other,i.e..they are **contagious**. The symptoms of this disease are: (a) soreness of the mouth (b) excess salivation and (c) lack of appetite. The affected animals have to be separated and their mouth and foot have to be cleaned with hot water. Vaccines are administered nowadays to counter this disease.

13.2 Sheep and Goat

Sheep and goat are reared for their meat, wool, milk, fur and hide. They move about in groups known as 'flocks' and are reared in dry lands. The sheep have a life span of 10-12 years. They feed mainly on grass, weeds and green herbs. Chaff and seeds are mixed with these and fed to them. These animals are sheltered in dry and well-ventilated sites as they have a tendency to catch cold.

The sheep are reared mainly for their wool. The removal of wool from the sheep is termed as **shearing**, Fig. 13.3. Before shearing these animals are washed and cleaned. Wool is removed only when the sheep is dry. For quicker and uniform shearing, a shearing machine may be used. The advantage of machine shearing is that the fibre of the wool produced has uniform length. After shearing in order to prevent infection by lice and ticks, the sheep are dipped in solutions of DDT, sulphur or gammexane.

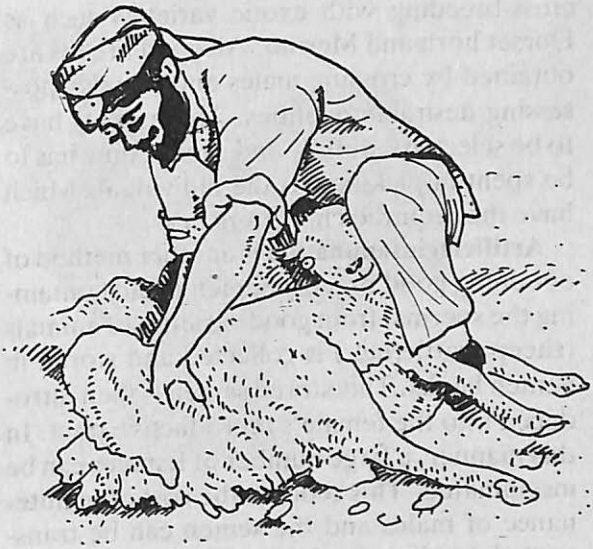


Fig. 13.3 Farmer shearing his sheep.

The quality of the wool produced varies from one breed to another. The wool is marked for quality on the basis of thickness, length, shine, tensile strength and colour of fibre.

Sheep and goat tend to suffer from communicable diseases. Sheep generally suffer from blocked nose, pneumonia which causes them difficulty in breathing. As a cure, they are made to inhale vapours containing eucalyptus oil. They also suffer from lesions of foot and mouth and during this condition, they run a high temperature, become slack and lose appetite.

Breeding

Good local breeds of sheep are obtained by cross-breeding with exotic varieties such as Dorset horn and Merino. All good breeds are obtained by crossing males and females possessing desirable qualities. The parents have to be selected carefully and a lot of time has to be spent in picking out the individuals which have the required characteristics.

Artificial insemination is another method of obtaining good breeds. Semen (fluid containing the sperms) from good varieties of animals (sheep, cattle, etc.) is collected and stored in Semen banks. This stored semen is then introduced into the female's reproductive tract. In this manner, a large number of females can be inseminated. This reduces the cost of maintenance of males and the semen can be transported to distant places. This technique is gaining popularity in livestock management.

13.3 Pigs

The management and breeding of pigs are together known as **piggery**. These animals are unable to digest fibrous food as they have a small alimentary canal. They are given food individually in order to allow the weaker ones to have an equal share. The pigs are fed on boiled potatoes, barley and linseed cakes.

The shelters for these animals should be strong and clean. A proper drainage system should be available. The pig **styes** as the shelters are called, are made of straw and bamboo or wood.

Pigs tend to suffer from various diseases. These diseases mostly spread through urine. This is the reason why the pig stye must have a proper drainage system in order to prevent the urine from draining from one stye to another. If the animals appear lethargic and suffer from constipation, they are suffering from a disease called **diamond disease**. This disease spreads through the urine and the dung of the suffering animals. This disease can be prevented by vaccinating the animals sufficiently early.

The pork that is obtained from the pigs has to be processed properly. These animals feed on human faeces and get infested with tape worms present in it. If the pork is not well-cooked we have a chance of being infected with these worms.

13.4 Poultry

Domestication of a group of birds (hens and cocks), for the purpose of obtaining eggs and meat from them, is known as **poultry** farming. The domestic fowls can be identified as males and females on the basis of certain external characteristics. The cocks (male) have a plumed tail, a comb and wattles on the head, (Fig. 13.4). These birds are easy to maintain as they can survive under various climatic conditions.

The common feed of these birds includes grains, oil cakes, green food and limestone. Limestone helps in the digestion of food and in the formation of the egg shells. Their food is given in a trough or spread on the ground. For proper egg production, a lot of water is needed by the poultry birds.

The shelter for these birds should be comfortable and safe. The hen-houses, called pens, are generally made of metal or wood because mud houses may be attacked by rats or snakes. Straw is used to cover the floors. Wire-meshes are used for covering, to prevent the birds from escaping.

A hole can be dug in the pen and filled with dust or dry ash. This enables the birds to have a dust bath which is a preventive against external parasites. The poultry birds should be cleaned regularly and the extra food and excreta should be cleared away to prevent diseases.

The hen lays the eggs and sits on them to

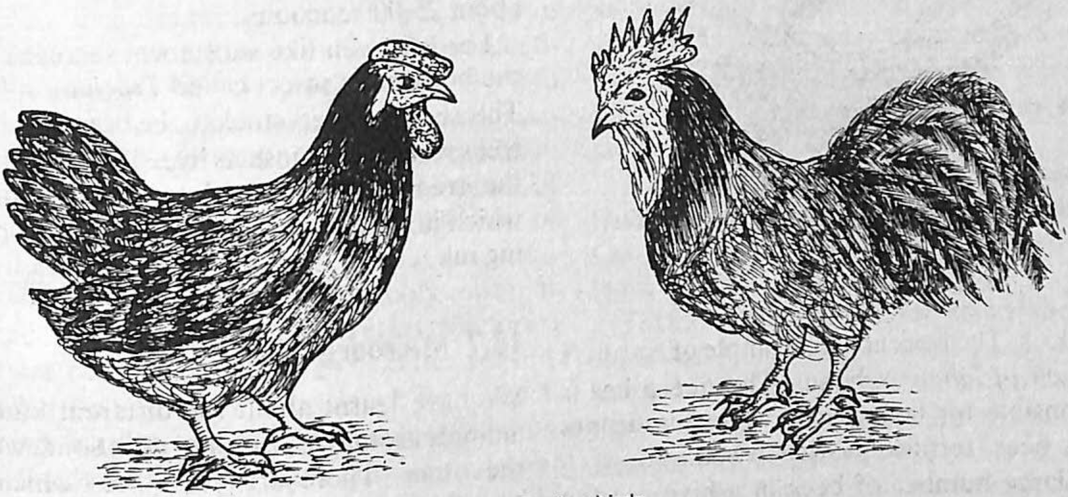


Fig. 13.4 Poultry birds.

provide the warmth necessary for hatching. In poultry farms machines known as **incubators** are sometines used to hatch the eggs. The incubator has certain advantages over natural hatching. These are, the eggs can be hatched throughout the year and a lot of eggs can be hatched simultaneously. Also the chicks produced are free from diseases which may infect them during natural hatching.

The poultry birds suffer from diseases such as fowl cholera, chicken-pox and Ranikhet. These diseases can even be fatal. Besides these, the birds may get infected with various internal parasites, such as round worms and tapeworms. External parasites that normally infect these birds are fleas, fowl mite, etc. As a preventive, vaccination should be given and the infected birds should be separated from the rest.

Some good breeds of fowls are White leghorn, Rhode island red, and Minorca. Such breeds can lay about 230-240 eggs a year.

13.5 Fishery

You all know that India has a long coastline. The Indian subcontinent is surrounded on three sides by water and the coastal areas provide a rich haul of fishes. They are a rich source of animal protein and can substitute other sources of this protein. Nowadays fishes and other aquatic animals are cultivated on an industrial scale in large water reservoirs.

Fishery is now a flourishing industry in our country. Prawns, shrimps, lobsters, edible oysters are exported on a large scale. Fishes not only provide proteinaceous nourishment but the oil of the fishes can be used for various purposes. Corals are used as decoration pieces, pearls from oysters are used in jewellery. Some important fresh water fishes are Catla, Labeo, Barbus and Tinca. Marine fishes found in India are Hilsa, Sardine, Mackerel,etc.

13.6 Insects

A large variety of industrial and commercial products are obtained from insects. **Apiculture** is the management of bees, which produce honey and wax. The bees build their homes called **bee hives** on branches of trees,

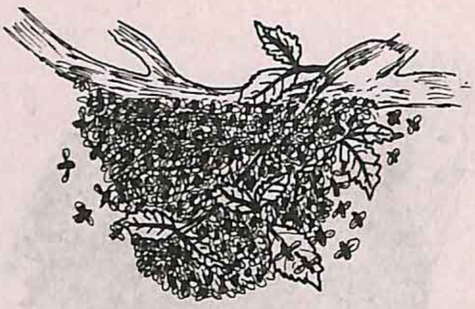


Fig. 13.5 A bee hive.

Fig. 13.5. The bees are an example of Nature's *division of labour* scheme. The **queen bee** is responsible for laying eggs while the **drones** (male bees) fertilise the queen bee.

A large number of bees in a hive are the **workers** who do the main work of maintaining the hive. The hives have many units or chambers called **combs**. The worker bees collect nectar from flowers and convert it to honey which is stored in bee hives. Honey contains water, sugar, minerals and enzymes which help in digestion of food. Honey also serves as an antiseptic. Another product of bees, bee wax, is used for making candles, moulds, etc.

Breeding, alongwith the management of the silkmoth is together known as **sericulture**. The silk moth produces the silk yarn. You have already studied the life-cycle of the silk moth in the 2nd chapter of this book. The caterpillar feeds on the mulberry leaves and secretes a sticky fluid from its salivary glands which forms a long thread of fine silk. The threads are wrapped around the body of the caterpillar forming a case called a **cocoon**. A single pupa, as the caterpillar is called in this stage when it is undergoing changes inside the cocoon, produces nearly 300 metres of silk yarn.

Silk for commercial use is obtained by treating the cocoons with hot water (to kill the pupa inside it). The silk is then unwound from the cocoons and twisted into threads. It may be noted that 454g of silk is obtained from about 25,000 cocoons.

Lac is a resin-like substance, secreted from the body of an insect called *Trachardia lacca*. This secretion gets stuck to the branches of the trees where these insects live. The scrapings of the trees are processed to prepare **shellac** which is widely used in varnish, polish, printing ink, etc.

13.7 Microorganisms

We have learnt about the different kinds of animals around us, useful to us in some way or the other. There are yet others which are equally useful but remain hidden from the naked eye. They can be observed under a microscope only and so, are called **microorganisms.** These are found practically everywhere, in air, water, food, soil, etc. It is indeed fortunate that only some of them are harmful or else we would not have had much chance of survival. In this section we will study about the useful ones.

Certain types of bacteria (one such microorganism) enrich the soil by helping in the decay of organic matter (dead remains of plants and animals). They convert the complex organic substances present in these dead remains into simpler inorganic substances namely nitrates, phosphates, sulphates, etc. The plants are then able to absorb these nutrients directly from the soil.

Rhizobium a soil bacteria 'fixes' nitrogen from the atmosphere to form nitrates, and therefore is also known as nitrogen-fixing bacteria. They are present on the roots of leguminous plants such as peas and pulses, and these are grown by the farmer in between other crops to restore the fertility of the soil.

Certain microorganisms produce chemicals which can kill some disease-causing bacteria These chemicals are known as **antibiotics.** **Penicillin** discovered by Alexander Fleming, is one such antibiotic. There are a range of antibiotics which help in curing many infectious diseases. Vitamins, such as Vit. B_{12} and Vit. K are obtained from the bacteria *Lactobacillus* present in the intestine of the host. Bacteria present in the alimentary canal of herbivorous animals help in the digestion of cellulose.

Yeast, another type of microorganism, is used in bakeries and breweries (factories where beer is prepared). In bakeries yeast is added while preparing the dough from which bread is to be made. The dough is left in a warm place where the yeast cells can multiply. As they multiply they produce carbon dioxide gas which occupies a lot of space inside the dough and makes it rise (i.e. makes it light and fluffy). The alcohol produced in the process evaporates during baking.

In the preparation of wine and beer, yeast is added to the grape juice and barley grains respectively, along with sugar. The yeast cells multiply to produce carbon dioxide and alcohol. The froth in these drinks is due to carbon dioxide and the intoxication they cause is due to the presence of alcohol.

Spoilt wine contains a bacteria, **Acetobacter** which converts the wine to a form of vinegar. Vinegar can be prepared from barley grains and grape juice by the action of the bacteria Acetobacter. So we see that microorganisms serve us in different ways.

However, it would be wrong to say that microorganisms are always useful because some are known to cause some dreadful, infectious diseases. You will be reading about a few of them in the last chapter of your book.

13.8 Harmful Animals

There are certain animals and insects which cause a lot of harm to our health and also to our crops. Such animals and insects are known as **pests**. For instance, grasshoppers, beetles and rice-weevils cause enormous damage to our agricultural crops and thus affect their yield. Stemborer (an insect) bores into the stems of paddy.

A number of insects feed on flowers and fruits and they can spread viral infections. Caterpillars or larvae of insects feed on the leaves of trees on which they live.

Further, crabs are known to cut the young stems of paddy crops while snails feed on young leaves and flowers. Certain mammals like rats and rabbits eat up stored grains. Besides this, rats were responsible for spreading plague. Wild bears, wild elephants, and deer also cause serious damage to crops. Birds such as sparrows, pigeons and parrots feed on fruits and seeds and cause severe loss to the farmers.

Parasites such as lice and ticks live either on the surface of the skin or just below it in animals. Leeches present in fields attach themselves to exposed parts of the human or animal body and suck the blood. These are the **ectoparasites** which live outside the body of the host. Other parasites (**endoparasites**) stay in the intestine of man and other mammals.

Tape worms attach themselves to the wall of the intestine through suckers and absorb the partly digested food present in the intestine of the host. The human faeces contain the eggs of tape worms and is eaten by pigs. These eggs develop into **bladder-worms** which enter the blood-stream and ultimately get embedded in the muscles of the pigs. This is the reason why pork should be well-cooked.

Besides these there are microorganisms which cause several dreadful diseases in man and other animals. Malaria, Dysentery Smallpox, Tuberculosis,etc.,are some diseases caused by these organisms. You will study about them in some detail in the last chapter of this book.

EXERCISES

1. What do you understand by the term breeding?

2. Why must the unwanted animals be separated from the rest?

3. What are the diseases that affect the sheep and the goats?

4. What is the use of semen banks?

5. Explain why pork should be properly cooked before eating?

6. What is the common feed of the poultry birds?

7. What are the advantages of using an incubator for hatching eggs?

8. Why is fishery a flourishing industry in our country?

9. List the various uses of honey.

10. How are the following harmful to man?

    a) Insects

    b) Birds

c) Tape worms ____

____

____

____

11. Match the following:

a) Domestication	1) a breed of fowl.
b) Contagious	2) breeding of silkworms.
c) White leghorn	3) keeping animals for specific uses.
d) Sericulture	4) parasites living outside the body of the host.
f) Ectoparasites	5) disease transferred from one animal to the other.

12. Bacteria are useful to us in many ways:

(i) ....

(ii) ....

(iii) ....

(iv) ....

(v) ....

(vi) ....

13. In ____________ yeast is added to the ____________ from which bread is to be prepared. The yeast cells multiply to produce ____________ ____________ which makes the dough ____________ and ____________. In breweries yeast is added to ____________ ____________ and ____________ ____________ along with ____________ to prepare wine and ____________ respectively. The intoxication caused by these drinks is due to the ____________ produced by the yeast cells.

Conservation

Coal, oil, natural, gas, soil, water, forests and other vegetation, and the living organisms that live in them are all useful to us in various ways. These are our **natural resources**. Some of these such as soil, water, forests, etc., are **renewable resources**, because once used, they can be restored or grown back within a *reasonable* period of time.

Coal, oil, natural gas, metallic ores etc. are **non-renewable resources**. Once they are used up there is no way of getting them back again, because their natural formation takes millions of years. Coal, oil, natural gas, etc., are energy yielding substances and are known as **fossil fuels**. They were formed from the remains of dead plants and animals that lived millions of years ago.

We have inherited the wonderful world we live in and all its natural resources from our parents. In the times to come we will hand it over to our children. We have the responsibility of preserving our natural resources. We have to use these natural resources in a wise manner. This *wise and judicious use of our natural resources* is known as **conservation**. An active programme of conservation is very important for the future of any nation.

14.1 Soil Conservation

Soil can be considered as the basis of prosperity of a country, because grains, vegetables and fruits grow in the soil. Herds of cattle and flocks of sheep get their food from the rich grasses that grow in the soil. It is very important to preserve the fertility of the soil. Continued planting of agricultural crops deprives the soil of its mineral matter.

The important mineral salts which are heavily used up by the plants are salts of nitrogen, phosphorus and potassium. These mineral salts may be restored to the soil by the application of commercial fertilizers such as **urea**, **superphosphate**, **ammonium chloride** etc. In addition to this, farmers normally practice **crop rotation**. This involves the sowing of two crops alternately, so as to restore the soil fertility. After a cereal crop is harvested the land is tilled again to grow a leguminous (pulse) crop. These leguminous plants support nitrogen-fixing bacteria on their roots. These bacteria can produce nitrates from atmospheric nitrogen and hence enrich the soil.

Sometimes water and strong winds may carry away the top soil rich in organic matter causing **soil erosion**. When the forests and natural vegetation are cleared, due to over grazing of herds, or to get more tillable land it exposes the soil to air and water. The flood waters and the violent dust storms remove the top soil. As a result the top soil often gets scattered far and wide by the winds or the water takes it to the bottom of the sea.

Soil erosion can be prevented by planting rees in rows (**wind breakers**). Soil must be firmly held by the roots of grass and other soil binding plants. On slopes of hills **terraces** can be made to prevent soil erosion. *Van Mahotsav* is one such attempt to consciously plant trees so as to prevent soil erosion.

14.2 Water Conservation

Conservation of fresh water is becoming more and more difficult in many areas. This is largely due to expanding industries, indiscriminate felling of trees, soil erosion and increasing population. Rivers get polluted due to sewage and industrial wastes dumped in their water. Uneven distribution of rainfall may also cause drought and desert conditions.

Top soil acts as a sponge in holding water when it rains. Once the top soil is completely soaked water moves down into the soil and reaches the **water table**. When the top soil is removed the amount of water that reaches the water table also becomes less. Due to increased use of ground water in the cities the water table goes down. In order to get water wells may therefore have to be dug deeper every year. Water pollution is harmful for marine life as well.

Large, naturally, occuring depressions in the ground, in hilly regions store rain water trickling down the mountain slopes. These depressions are called **catchment areas**. Cutting of trees in hilly regions would expose the soil and cause its deposition in the catchment areas. This makes the catchment area shallow and incapable of storing water, which results in the flooding of rivers during rainy season and drought during summer.

As a means of conserving water, our government has constructed dams in several parts of the country. These dams are great reservoirs of water and help in preventing floods. In addition water pressure in the dams is used to generate electricity. Conservation of water may be possible by **afforestation** (planting of trees) and controlling the use of ground water in cities. The waste water from the industries and houses may be purified and recycled for irrigation purposes.

14.3 Preservation of Forests

You already know that plants are a distinct benefit to mankind as they provide a variety of products. Roots of trees bind the soil and prevent soil erosion. The fallen leaves form a protective cover over the soil. When these leaves decompose, they form **humus** which adds to the fertility of the soil.

Forests purify and also modify the climate over large areas and influence rainfall. Expansion of agriculture and urbanisation has led to the indiscriminate cutting of forest trees. Bush fire also poses a threat to the forests. Scientific management can protect our forests from bush-fires, prevent diseases of trees, help to get maximum yield of timber and forest products such as gum, resins, tannins, etc.

Forest which is managed well, yields timber for cutting at regular intervals. Weeds, damaged trees, crowded trees, crooked and diseasedtrees should be removed. **In block cutting**, trees of almost the same age are cut and new trees are planted. Forests are also preserved as national parks.

14.4 Conservation of Wild Life

Wild life refers to animals that live on land and includes those living in water. Spreading cities and vast agricultural lands have posed a threat to wild life. Pollution of water with sewage and chemical wastes from industries have destroyed **aquatic** (living in water) animals. Cutting of forests disturbs the natural habitats of several birds and animals.

Killing or hunting of animals for their fur, hides,etc., also contributes towards the extinction of wild life. Much of the destruction of wild life takes place due to our carelessness. A large number of animals such as orangutan, gorilla, tiger, polar bear are being threatened by the possibility of extinction, unless man comes to their rescue with strict protective measures.

The best way to conserve these animals is by establishing large areas where hunting is prohibited. When their number becomes large, restricted hunting may be allowed. Several such wild life sanctuaries exist in our country such as Corbett National Park, Kaziranga sanctuary, etc.

Today the International Union for the Conservation of Nature and Natural Resources (IUCN) and the World Wild life Fund are the two main agencies taking steps to protect the endangered species.

Conservation is everybody's duty. The basic contribution one can make is to keep in mind that natural resources are *exhaustible* and hence should not be over used or misused. Natural resources should be used with due regard to the needs of the future generations.

EXERCISES

1. Conservation is:
2. Name the renewable and non-renewable resources.
3. What is the use of crop rotation?
4. How can soil erosion be prevented?

What are the causes of water pollution?

6. Why should forests be preserved?

7. Explain what is a catchment area and how cutting of trees affect it.

8. How is man responsible for the extinction of wild life?

9. Name the two agencies which are taking steps to protect the endangered species.

15

Diseases and Man

Our ancestors, when they fell ill usually attributed their illness to the wrath of the gods. Diseases swept through communities killing large numbers of people. Today man knows the cause of a majority of those diseases and hence no longer fears them. Individuals particular about their personal health and hygiene can protect themselves from these diseases. Any impairment in the normal structure and function of the body may be called a disease. There are mainly two types of diseases—**infectious** and **non-infectious**. The non-infectious disease may be due to the malfunctioning of any organ system of our body or some hereditary disease such as haemophilia or colour blindness. These diseases cannot be transmitted from one person to another by contact or by being close to the patient over a period of time. Diabetes, thrombosis and deficiency diseases also belong to this category.

Infectious diseases are caused by the entry of disease-producing germs or **pathogens** into the body. Viruses, bacteria,fungi, protozoans and certain worms are the pathogens that affect the human body. These pathogens, i.e., virus, bacteria, fungi and protozoans, are all microorganisms and thus are visible only under the microscope. Infectious diseases can be transmitted from one person to the other by personal contact or through the air we breathe, the water we drink and the food we eat. The pathogens present in any of these media can affect us.

15.1 Diseases caused by Viruses

Viruses are extremely small organisms consisting of a **nucleic acid** core surrounded by a protein layer. They cannot exist freely in nature but can live inside some other living cell. Once inside the cells of the host they take over completely and produce more virus cells. The individual whose body the virus has invaded suffers from the disease.

Viruses cause diseases like chicken pox, poliomyelitis, small pox, mumps, common cold, influenza, rabies, viral encephelits, measles,etc., in man. Let us study symptoms and preventive measures of some of the common viral diseases.

Chickenpox

Most of us have suffered from the disease in our childhood. Those of you who have had this disease must have heard your parents say that you picked it up from some friend of yours who was suffering from it. It spreads by means of droplets or spray when the infected person coughs or sneezes or by the hands. It is believed that at times it can spread by articles used by the infected person. Once you are exposed to the virus it takes fourteen to twenty days for the symptoms to develop (**incubation period**).

A rash resembling red pimples appears, in successive crops and develops into pearly blisters. The rash may appear on the chest, face, scalp, abdomen and limbs and fresh crops of spots appear at intervals. Scabs form in a couple of days and fall off to leave shallow scars most of which heal with time. The last of the scabs fall off in about fourteen days and the patient is generally isolated till then.

The disease is probably the mildest of childhood infections and once you have it you acquire lasting immunity. Chickenpox in adults may be much more intense than in children and deep scars may remain.

Mumps

This viral disease is characterised by acute inflammation and swelling of the glands beneath the lower jaw. The incubation period varies from twelve to twenty-six days. Infection spreads through contact and crockery as the virus is present in the saliva of the patient.

Infectivity is not high in this disease. There are painful swellings just below the lower jaw which may spread towards the cheeks. Any movement of the jaw causes severe pain and the patient also has problems swallowing food. The patient may be given a liquid diet to minimise jaw-movement. Recovery is almost invariable, but painful complications can occur.

As a preventive measure the patient must be isolated, usually for a week after the swelling has subsided. Crockery and other utensils, handkerchiefs and other items of clothing used by the infected person should be disinfected by boiling. Though a mildly infectious and a certainly curable disease, it causes the victim a great deal of discomfort and pain while it lasts.

Influenza

It is an acute and highly infectious disease. Infection spreads from person to person by means of droplets released when an infected person coughs or sneezes. Nasal discharges are another means of spreading the virus. Symptoms appear within three days and the patient suffers from a wide and varied range of them. The victim may have high fever, body ache accompanied by chest congestion.

There may be complications in case of severe infection, broncho-pneumonia being the most common of them all. Another complication is the inflammation of the heart muscles and either of the two can be fatal. To avoid the severity of the disease the victim must take to bed as soon as there is a suspicion of it.

The victim must avoid public places and modes of conveyance, so as not to infect others. Infants and young children must not be exposed to infected persons. Personal measures for prevention are, avoiding unnecessary exposure to extreme climatic conditions, physical or mental fatigue. Rest and isolation together with prompt medical attention are required for quick recovery.

Measles

It is a common disease among young children, and is probably one of the most infectious diseases. It spreads from infected persons only and not through carriers. Earlier, death rate due to measles was high amongst children, mainly because of broncho-pneumonia. No community is immune to it and it can be fatal for adults too if the population has not acquired any previous immunity.

Measles has an incubation period of ten days from the day the first symptoms appear. The early symptoms are a cold in the head which gradually spreads to the upper respiratory tract. It is during this phase of the disease when there is nasal discharge that the patient is most infectious to others.

Other symptoms are fever, reddening of the eyes and cough. A rash appears on the fourth day and for fourteen days after its appearance the patient is isolated. Antibiotics are available to prevent complications and a second attack of measles is rare. A measles vaccine can be administered these days to allow the child to develop a resistance to it.

Poliomyelitis

This disease is probably the most dreaded of all the viral diseases as it may leave a lasting paralytic effect on its victim. Earlier it was known as infantile paralysis but now it is known to attack young adults, including those in middle life. It is a disease of temperate climate, with maximum attack during the hottest part of the year.

The incubation period is usually seven to fourteen days but it may extend to twenty-one days. The virus attacks the motor nerves of the brain and spinal cord and if these happen to die paralysis of the muscles controlled by them results. One muscle or a group of muscles may be paralysed rather than a whole limb. If centres in the brain controlling breathing and swallowing are affected death may result if prompt and efficient medical care is not provided.

The symptoms shown are high fever, stiffness in the neck and weakness. The disease may spread by direct contact but mostly it is by way of carriers. The virus may be expelled from the nose or throat as droplets or through the faeces of victims. Every attack does not ensure paralysis and even when it occurs it is worst at the onset but tends to improve with time and treatment.

Preventive measures include isolation of the patient for six weeks and disinfection of the discharges and excreta from the patient. Polio vaccine is available nowadays and it must be administered during infancy followed by a booster dose every few years. This immunises the child against this crippling disease.

15.2 Bacterial Diseases

This category of diseases is caused by bacteria, another group of microorganisms. Though microscopic in size they are larger than viruses. The difference does not end here but extends to the former's ability to grow and reproduce without a host cell. Bacteria may be present anywhere, in air, water, soil, in and on decaying organic matter and even in and on living organisms. The pathogenic bacteria cause a range of diseases, of which you will be studying a few.

Typhoid Fever

It is commonly and rightly believed that this fever flourishes where the personal hygeine of people is at fault and sanitary conditions ~~are~~ poor. Typhoid bacilli enter the body with food or water contaminated by the excreta of the patients or of the carriers of the disease. In hot countries like ours the disease may be transmitted by infected dust or flies which first fed on infected excreta and then on human food.

Milk and its products, cooked meats, salads, fruit, and shell-fish are most easily contaminated by typhoid bacilli. The disease has an incubation period of 12–14 days and the patient is infectious till tests confirm that he no longer houses the bacteria. Symptoms include high fever, headache, sickness, diarhhoea or constipation and the illness persists for some weeks with prolonged convalescence.

Care should be taken or else serious complications may occur. Preventive measures include isolating the patient, disinfecting everything used and touched by him or her and inoculation. Food and drink must be protected from contamination by flies. An eye must be kept on the health and sanitary conditions of the locality, also the water supply must be tested for infection.

The T.A.B. vaccine may be administered as a preventive, in areas with improper sanitation. The vaccine has a mild dose of the typhoid bacteria and builds the individual's own immune system.

Tuberculosis

This disease caused by the tubercle bacteria is predominant in faulty environments and areas with low standards of health. It may spread from a human source or an infected cow. The bacteria from the latter source generally attacks children in bones and joints of the hip or spine and glands of the neck. The human source spreads the infection by means of the discharges from the air passages of the infected person.

The droplets released from the coughs or the sputum of the patient carries the bacteria. This bacteria from the human source can attack any part of the body but usually it affects the lungs. Though many may be exposed to the infection only a minority develop the disease. The patient must be isolated and the crockery, and other articles used by him should be cleaned separately.

Infectivity is low in this disease and most people have a considerable degree of resistance to it. Taking a balanced diet, adequate sleep and fresh air and avoiding prolonged fatigue can go a long way in preventing this disease. Personal hygiene, such as blowing one's nose into a handkerchief and spitting in spitoons should be observed.

Modern methods of diagnosis such as *X*-rays and skin tests together with B.C.G. vaccine can fight this disease effectively. Today farmers ensure that their herds of cattle are free from tuberculosis and also milk and its products are pasteurised to minimise its incidence.

Pneumonia

Pneumonia means inflammation of the lungs and it could be caused by a variety of reasons. One type of pneumonia affects the entire lobe of one or both lungs. In broncho-pneumonia the inflammation is in patches, scattered throughout both the lungs. Broncho-pneumonia can occur either as a separate disease or as a complication of some other infection, for example measles.

Pneumonia occuring as a disease by itself is highly infectious. The infection spreads by way of droplets released from the infected person or through an intermediary carrying the bacteria in the upper respiratory tract. The exact incubation period is uncertain but is short and the attack is sudden. There is acute congestion in the lungs, and the patient has difficulty in breathing.

Before the advent of penicillin pneumonia was responsible for causing many deaths. But modern antibacterial drugs have reduced the mortality rate of this disease. The patient is given antibiotics and allowed to recover though he is not isolated. Repeated bronchial attacks can leave patches in the lungs and thereby lead to bronchial asthma. Deep breathing in fresh air can increase the lung capacity and reduce the bacterial patches in the lungs.

Avoiding unnecessary exposure and strain can check an attack by this bacteria.

Tetanus

It is an infection caused by the bacteria *Clostridium tetani* and can be fatal if proper measures are not taken. Tetanus results generally from the infection of a wound or raw surface with this bacteria. The cut may be too trivial to be noticed and may get infected by the street dust or soil containing the bacteria. Tetanus is also caused by the use of unsterilised injections.

Any break in the skin does not result in a tetanus. The bacteria lies dormant in the soil and on entering the body waits for proper conditions to multiply. Tropical rural areas are more prone to attacks of tetanus owing to a warm climate and unhygienic conditions. The incubation period varies from 2 days to several weeks but is usually 6 to 12 days.

The toxin produced locally causes muscle rigidity and spasms. In man the spasms develop in the muscles of the head and neck and then spread downwards. Lockjaw causes the jaws to stiffen and is the earliest symptom. Medical attention should be administered right at the onset of rigidity. If there is a sepsis around the wound it should be cleaned and an ATS (anti-tetanus serum) injection should be given.

The tetanus patient should be treated in a hospital. Active immunisation is the best preventive. A dose of tetanus toxoid is given which enables the individual to develop antitoxins against the toxin injected. The booster dose consists of 3 doses right at infancy followed by one in the first year at school and another while leaving school i.e. 15–19 years of age.

15.3 Other Microbes affecting Man

Besides viruses and bacteria certain protozoans such as *Entamoeba histolitica* and plasmodium also cause diseases in man. You have already studied about certain worms such as tapeworms, hook worms and round worms which are parasites in the human intestine causing considerable damage to it. The diseases caused by these protozoans and worms are generally due to unhygienic and poor sanitary conditions.

Amoebic Dysentry

Caused by *Entamoeba histolitica*, this disease spreads from the faeces of infected persons. Contamination of food and water by flies and infected food handlers are instrumental in spreading the disease. The amoeba makes its home in the mucous membrane of the intestine and causes repeated attacks of diarhhoea. The incubation period is usually 3–4 weeks and the patient may remain infective for many years unless treated.

Control of dysentry essentially means improving sanitation and sewage disposal facilities. Water and food must be protected against contamination and flies controlled. Particular attention must be paid to the cleanliness of the hands.

Malaria

A disease common in tropical and sub-tropical areas, malaria is caused by the protozoan plasmodium. It is transmitted from person to person by the female anopheles mosquito. Its bite injects the protozoan into the victim's blood. It is characterised by high fever, recurring at regular intervals with shivering. Chloroquin is administered to patients suffering from malaria.

Mosquitoes breed in stagnant water, so proper drainage facilities is essential to combat with this menace. Also use of mosquito nets and mosquito repellants can avoid this disease. Insecticides such as D.D.T. have helped to check the population of these insects.

EXERCISES

1. Choose the correct answer.

(i) Diseases which spread by personal contact or through air, water or food. (infectious/non-infectious)

(ii) A rash resembling red pimples appears and develops into pearly blisters. (measles/chicken-pox)

(iii) The virus is present in the saliva of the patient. (mumps/polio)

(iv) Painful swellings appear just below the lower jaw and spread torwards the cheeks. (influenza/mumps)

(v) Symptoms are fever, reddening of the eyes and cough accompanied by a rash. (measles/influenza)

(vi) The virus attacks the motor nerves of the brain and spinal cord. (polio/typhoid)

(vii) The symptoms shown are high fever, stiffness in the neck and weakness and may cause paralysis of a limb. (tetanus/polio)

(viii) The disease spreads through contaminated food and water and causes diarhhoea or constipation along with fever. (typhoid/malaria)

(ix) The bacteria from the human source mainly affects the lungs and it can be checked by the B.C.G. vaccine. (tuberculosis/typhoid)

(x) A balanced diet, adequate sleep and fresh air and avoiding prolonged fatigue can prevent this disease. (pneumonia/tuberculosis)

(xi) There is inflammation in patches and acute congestion in the lungs which may lead to asthma. (pneumonia/influenza)

(xii) In man the spasms develop in the muscles of the head and neck and then spreads downwards. (tetanus/polio)

(xiii) The bacteria lies dormant in the soil and on entering the body waits for proper conditions to multiply. (dysentry/tetanus)

(xiv) Contamination of food and water by flies and infected food handlers spread this disease. (dysentry/typhoid)

(xv) It is characterised by high fever recurring at regular intervals with shivering. (measles/malaria)

(xvi) The protozoan makes its home in the mucous membrane of the intestine and causes repeated attacks of diarhhoea. (typhoid/dysentry)

(xvii) Caused in tropical and subtropical areas by the protozoan plasmodium. (polio/malaria)

(xviii) A microscopic organism which can grow and reproduce without a host cell. (virus/bacteria)

Understanding Science

Physics - Classes 6, 7 & 8
Chemistry - Classes 6, 7 & 8
Biology - Classes 6, 7 & 8

This series of nine books is planned according to the guidelines set by the NCERT, but caters to the needs of the ICSE syllabus as well. The approach is modern, yet simple. The important concepts, scientific terms and definitions have been highlighted to help the student to remember them easily. Concepts have been formed with the aid of innovative experiments so that learning becomes an enjoyable experience rather than a tedious ritual. The students can perform the experiments on their own with readily available apparatus. Each chapter has an extensive workbook section containing mainly short-answer and objective type questions.

Sangam Books

Menon, Mediratta & Theodore : UNDERSTANDING SCIENCE BIOLOGY Class VIII
ISBN 0 86131 658 4

Rs. 17.00